N65-88097
(ACCESSION NUMBER)
45
(PAGES)
CR 64623
(NASA CR OR TMX OR AD NUMBER)

(THRU)
None
(CODE)

(CATEGORY)

FACILITY FORM

RE-ORDER NO. 64-320

OPERATIONAL MANUAL

MARINER-C
VIDEO STORAGE SUBSYSTEM

JPL CONTRACT 950105
under NAS 7-100

RAYMOND ENGINEERING LABORATORY, INC.
MIDDLETOWN, CONNECTICUT

JULY 1, 1964

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1.0 SCOPE

1.1 This manual delineates the function and operation of the Mariner-C Video Storage Subsystem.

2.0 PURPOSE

2.1 The purpose of this manual is to provide the operator with information necessary to enable proper operation of the subsystem. Detailed operating procedures, waveshapes, and interface requirements are included to facilitate understanding the operational setup of the equipment.

3.0 REFERENCE DOCUMENTS

3.1 The following documents of the issue in effect may be used as reference material.

3.2 TEST PLAN

Raymond Engineering Laboratory
Model 1738 Recorder/Reproducer
General Test Requirements

3.3 OPERATIONAL MANUALS

Mariner-C Spacecraft Flight Equipment
Science Data Automation Subsystem
Operational Manual

Mariner-C Spacecraft Flight Equipment
Data Encoder Subsystem
Operational Manual

3.4 DRAWINGS

Jet Propulsion Laboratory
J4901042 Mariner-C Package Assembly

4.0 GENERAL DESCRIPTION

4.1 The Mariner-C Video Storage Subsystem, referred to as the recorder system throughout the remainder of this text, is an assembly of operating components used to record digitized television data in the Mariner-C spacecraft during a planetary encounter or flyby and to reproduce these data at a much lower rate in the time following encounter.

4.2 The recorder system accepts fully serial, return-to-zero (RZ) data from the Data Automation Subsystem (DAS) at a fixed rate of 10,700 bits per second and can store a minimum of 5.24×10^6 bits of video data equivalent to twenty television pictures. It reproduces for use in the Data Encoder (D/E), synchronous, fully serial, nonreturn-to-zero (NRZ), binary data at a fixed output rate of 8.33 bits per second.

4.3 Provisions are included for operating the recorder system, in a limited sense, during launch. This mode of operation terminates shortly after separation of the spacecraft from the carrier rocket (Agena).

5.0 PHYSICAL DESCRIPTION

5.1 A tape transport subassembly and four electronic subassemblies comprise the recorder system, which together with its wiring harness is mounted in one-half of Case V in the spacecraft structure.

5.2 TAPE TRANSPORT SUBASSEMBLY 16A1 - This hermetically sealed unit contains the basic tape transport mechanism in an endless loop configuration including drive motors, heads, and playback preamplifiers. In addition, temperature and pressure transducers are included for telemetry purposes.

5.3 ELECTRONIC SUBCHASSIS 16A2 - The major portion of the reproduce electronics is contained in subchassis 16A2 including the main playback amplifier, peak detection section, code converter, phase comparator, and data output stages.

5.4 ELECTRONIC SUBCHASSIS 16A3 - The remainder of the reproduce electronics consisting of the voltage controlled oscillator and playback motor drive electronics is located in subchassis 16A3. In addition, most of the record signal electronics and part of the control section are located here.

5.5 ELECTRONIC SUBCHASSIS 16A4 - Various supply voltages for the recorder system are generated by the main 2400 cycle supply located on subchassis 16A4. Record command circuits for controlling the record motor are also included.

5.6 ELECTRONIC SUBCHASSIS 16A5 - Subchassis 16A5 contains the launch mode circuitry, control circuits, and the remainder of the record signal electronics.

6.0 LEADING PARTICULARS

6.1 Performance Characteristics

6.1.1 Bit Capacity- 5.24×10^6 bits on two tracks of 1/4 inch tape, 330 feet long. Additional capacity is available in the form of wasted tape to allow for acceleration and deceleration before and after each recording interval.

6.1.2 Record Bit Rate- 10,700 bps RZ Data

6.1.3 Reproduce Bit Rate- 8.33 bps average NRZ Data; synchronization is achieved through the use of a phase locked loop tape speed control slaved to a bit sync submultiple.

6.1.4 Bit Error Rate- less than 1 in 10^5 bits not counting errors accumulated while establishing lock or due to track change at end of tape.

6.1.5 Record Mode Tape Speed- 12.84 ips

6.1.6 Reproduce Mode Tape Speed- 0.01 ips average when the system is phase locked. Speed will normally drift down to approximately 0.009 ips when operating over erased tape as a result of losing lock.

6.1.7 Launch Mode Tape Speed- 12.84 ips

6.1.8 Operating Temperature Range - the recorder system is designed to operate over a temperature range from -10° C to +70° C. In actual flight temperature is expected to remain between 0° C and +55° C.

6.2 Power Requirements

6.2.1 Electrical power for the recorder system is derived mainly from the 2400 cycle spacecraft supply. The record motor requires a special 400 cycle power source while recording (planetary encounter). Spacecraft gyro power is used during launch mode operation to run the record motor.

6.2.2 2400 Cycle Power

2400 cps, 100 volts peak-to-peak or
50 volts RMS squarewave:
3 watts record mode
4 watts playback mode

6.2.3 400 Cycle 1-Ø Power

400 cps ±1%, 65 volts peak-to-peak or
32.5 volts RMS squarewave

4.5 watts
8 watts motor start

6.2.4 400 Cycle 3-Ø Power (One phase only is used)

400 cps ±1%, 66 volts peak-to-peak or
24 volts RMS castled wave

0.2 watts standby
3.5 watts launch mode

6.3 Mechanical Characteristics

6.3.1 **Weight-** 16.81 lbs. total exclusive of cable harness

Subassembly	16A1	- 9.29 lbs
Subchassis	16A2	- 1.74
	16A3	- 1.71
	16A4	- 2.28
	16A5	- 1.79

6.3.2 Volume- 481 cubic inches total exclusive of cable harness, connectors, and mounting ears.

Subassembly	16Al	- 226 cubic inches
Subchassis	16A2	- 59.5
	16A3	- 59.5
	16A4	- 76.5
	16A5	- 59.5

7.0 FUNCTIONAL DESCRIPTION

7.1 Launch Mode (See Figure 1)

7.1.1 During the launch phase of the flight the tape transport is operated at record speed although no actual recording takes place. The record motor is started shortly before launch and continues running until after the spacecraft separates from the Agena rocket. After separation the tape is positioned automatically to the proper point in preparation for planetary encounter.

7.1.2 Referring to the Launch Mode Functional Diagram, Figure 1, launch mode control signals applied to the recorder system through the spacecraft umbilical can set or reset the magnetic latching relay. This is true whether gyro power is applied to the recorder system or not. Indication of relay position is obtained by monitoring the resistance appearing across the two umbilical lines.

7.1.3 If gyro power is applied to the recorder system and the latching relay is set by means of a launch mode ON signal, the magnetic bias relay will energize and start the record motor. The tape is set in motion whenever the record or playback motors are running; the record motor always overrides the playback motor. In launch mode operation the record motor drives the tape at the same speed as in record mode (12.84 inches per second), although acceleration to operating speed takes a longer time in launch mode. A pulse is generated for every complete pass of the tape by the auxiliary end-of-tape (EOT) circuit as an end-of-tape foil, spliced into the endless loop, passes over the EOT sensor contacts.

7.1.4 When the spacecraft separates from the Agena rocket, the EOT pulse is combined in an AND gate with the Agena separation signal. The AND result is applied through an OR gate and driver amplifier to the latching relay. This pulse resets the latching relay which in turn de-energizes the bias relay, thereby removing power from the record motor and locking out the launch mode circuitry. After the record motor and tape coast to a stop, the EOT foil is positioned at a point approximately two and one-half feet beyond the record/reproduce head. This is the normal tape position from which to start the encounter record sequence.

7.1.5 In the event that separation from the Agena is not clean and the separation signal does not occur because of shorted connector pins or the like, the record motor will continue running until the gyro power shuts down. Subsequent application of gyro power to the recorder system will automatically reset the latching relay by means of the delayed monopulse generator, thus locking out any further action of the launch mode circuits. Should the above take place, the tape may not be positioned properly for planetary encounter, and recording and picture capacity may be reduced to as low as ten pictures.

7.1.6 Launch mode operation of the recorder system overrides either record or reproduce modes, and for test purposes the system may be safely operated in this manner. As long as gyro power is present, launch mode ON and OFF signals applied to the umbilical lines will respectively start and stop the record motor.

7.1.7 Telemetry indication of record motor shut-down after spacecraft separation may be obtained by monitoring gyro supply power consumption. To facilitate testing, the signal developed across the record motor is brought out to the Operational Support Equipment (OSE) interface.

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7.2 Record Mode (See Figures 2 through 5)

7.2.1 Application of 2400 cps power and single-phase 400 cps power prior to encounter energizes all sections of the recorder system except those associated with the launch mode. Assuming that the tape is positioned properly, the recorder system is ready to record at least twenty picture sequences while making two complete passes of the tape, changing tracks after the first pass and returning to the initial track after the second pass. Response to record commands after the EOT foil passes the sensor contacts the second time is inhibited.

7.2.2 The recorder system utilizes the frequency doubled method of encoding the tape. This code is arranged so that there is at least one flux reversal in each bit cell. In this manner the clock is contained in the data sequences. Referring to the Record Signal Waveforms, Figure 2, note that a flux reversal always occurs at the boundaries of a bit cell. If the data is a logical "one", a flux reversal occurs also in the center of the bit cell. No reversal in the center of the cell indicates a logical "zero".

7.2.3 The absence of a playback command signal from the D/E conditions the system for recording by applying power to the record head drivers. (See the Record Mode Functional Diagram, Figure 5.) Thus whenever the recorder system is not operating in the reproduce mode, it is in the record mode and will record or erase the tape. Spot erasure of the tape will occur while the tape is stationary if the playback command signal is removed.

7.2.4 Application of the DAS RZ data pulses and sync pulses in the proper phase relationship to an OR gate and flip-flop generates the frequency doubled code. This signal is fed to the non-return-to-zero (NRZ) head drivers which in combination with the record heads magnetize the tape appropriately. Note that if data and sync pulses are not present, the tape will be biased continuously in one direction or the other, a condition which exists between recorded picture sequences. The NRZ method of recording allows re-recording over old data or erasure as the case may be. Frequency doubled code signals may be monitored at the OSE during test.

7.2.5 The start-stop record relay applies power to the record motor whenever in the START position. Control pulses from the DAS or OSE can position the relay to either state. A second set of contacts on the relay is used for monitoring purposes through the integrator monitor lines of the umbilical interface. This is done to verify that the relay is in the STOP position before launch. Should the relay be left inadvertently in the START position, the record motor would start running immediately upon application of 400 cps power before encounter. The record motor monitor is available as in launch mode operation.

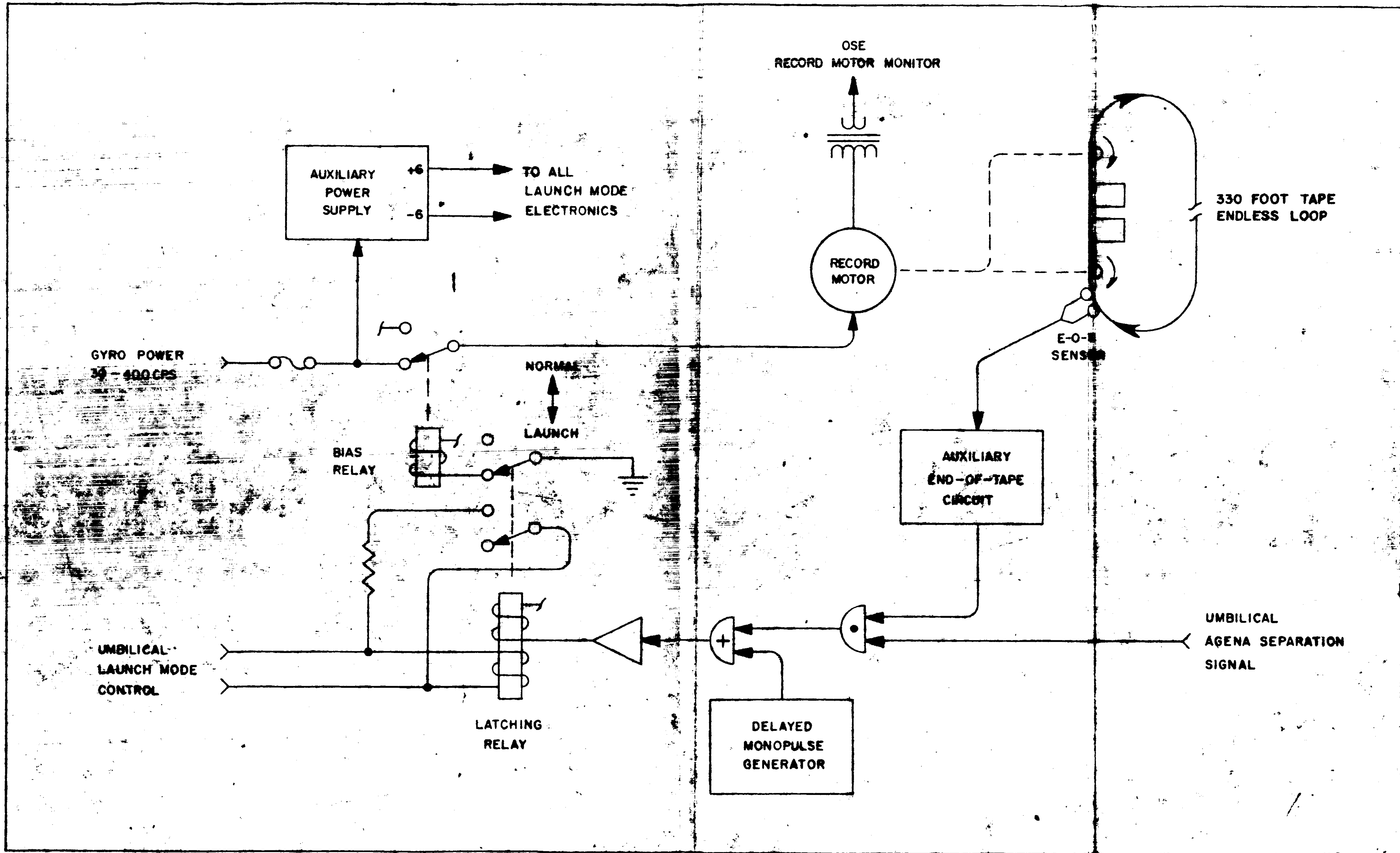

FIGURE 1. LAUNCH MODE FUNCTIONAL DIAGRAM

7. 2 Record Mode (See Figures 2 through 5)

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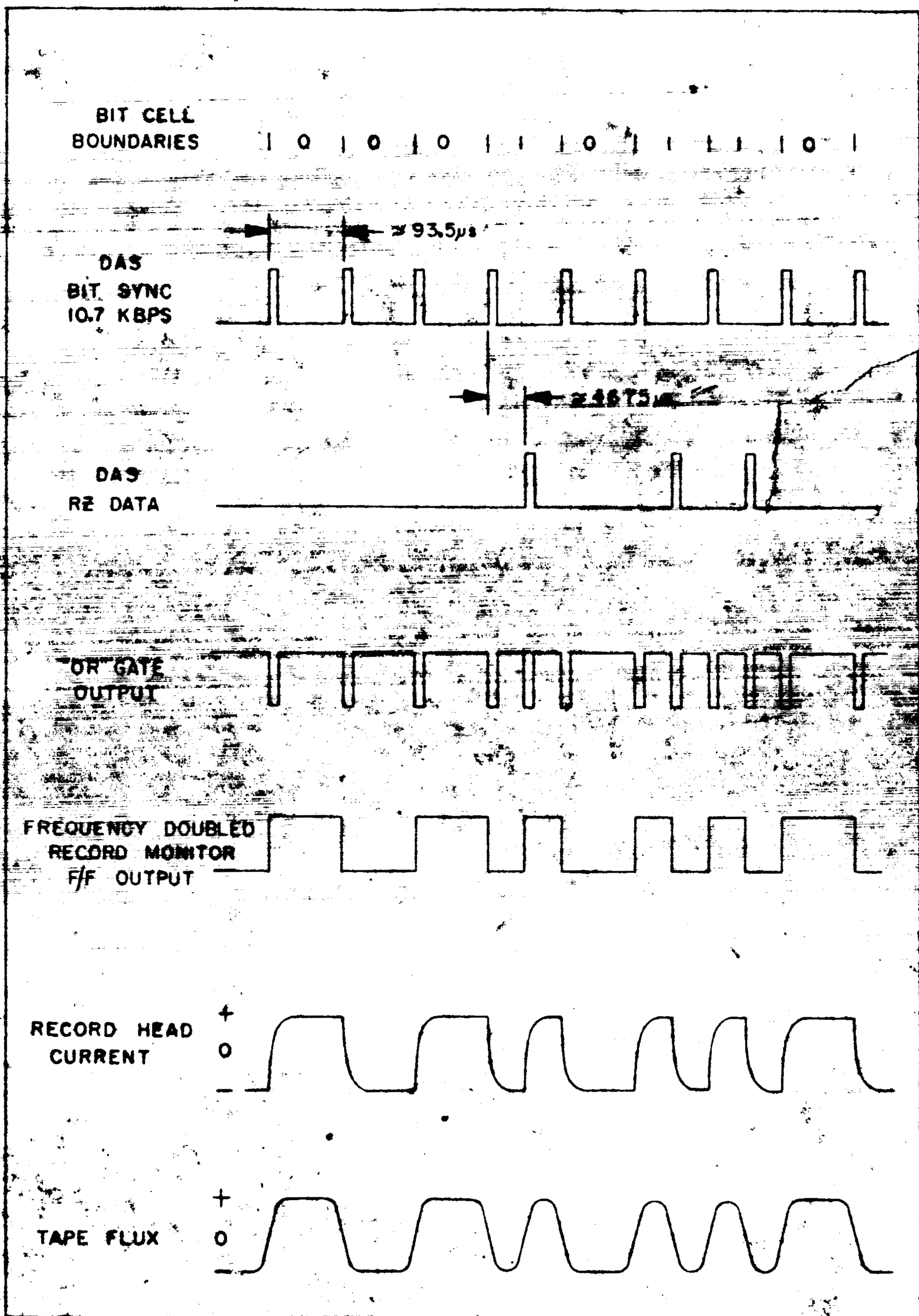

FIGURE 2. RECORD SIGNAL WAVEFORMS

7.2.6 During recording, a pulse is generated for each complete pass of the tape by the end-of-tape (EOT) circuit as the end-of-tape foil passes over the sensor contacts. This EOT pulse is applied internally to the track change and count-two sections of the recorder system and externally to the DAS, D/E, and OSE. In a normal planetary encounter record sequence, the DAS ignores the first EOT pulse and responds to the second if it occurs between the beginning of the nineteenth and the end of the twenty-second picture sequence. The DAS is mechanized to terminate encounter record sequences upon receipt of the second EOT or at the end of the twenty-second picture if an EOT pulse has not been received. This function is backed up by the count-two-and-stop section of the recorder. For telemetry purposes, EOT pulses register on an event counter in the Data Encoder. The EOT signal is brought out to the OSE for test purposes, mainly to index the tape transport to the beginning of the loop.

7.2.7 Track changes take place whenever the EOT circuit generates a pulse. The track change circuit incorporates a magnetic latching relay arranged in a bi-stable flip-flop configuration. Track indication is brought out to the OSE for monitoring purposes. An umbilical track step command is available as well as a track step command from the flight command subsystem.

7.2.8 End-of-tape pulses also trigger the count-two-and-stop circuits of the recorder system. This section functions automatically to issue a stop record command to the recorder and inhibit DAS start record commands upon receipt of the second EOT signal. The counter is reset to zero by the first DAS start record command acting through a monopulse reset generator. Further reset of the counter is impossible unless 2400 cps power is removed from the system. Once two EOT pulses have registered on the counter, it inhibits record start commands and has no further effect on the system.

7.2.9 A typical record sequence is delineated in Figure 4 entitled Picture Sequence Timing. Note that video data are delayed after a record start command to allow the tape to reach proper velocity before actually recording. The tape is erased during this delay and also during coast-down after a record stop command. Approximately six feet of tape are erased in this manner for each picture sequence. Sync pulses (all zeros) are applied 8 milliseconds before data so that errors are minimized as the system attains synchronization during the reproduce mode.

7.2.10 Pictures are recorded in two sequence frames as indicated in the Encounter Sequence Timing diagram, Figure 3. Sufficient time is allowed for the tape transport to come completely to rest between pictures. Track change will occur normally during the eleventh picture sequence and storage capacity will be reached during the twenty-second sequence.

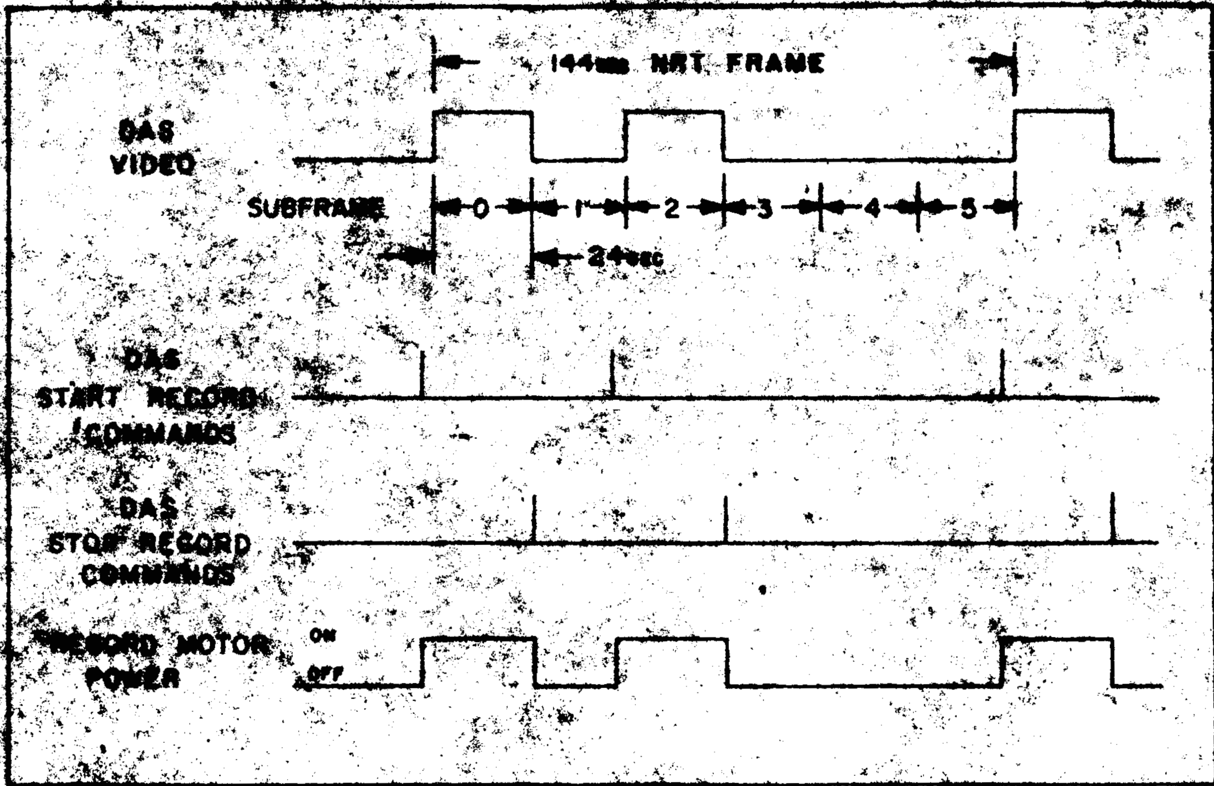

FIGURE 3, ENCOUNTER SEQUENCE TIMING

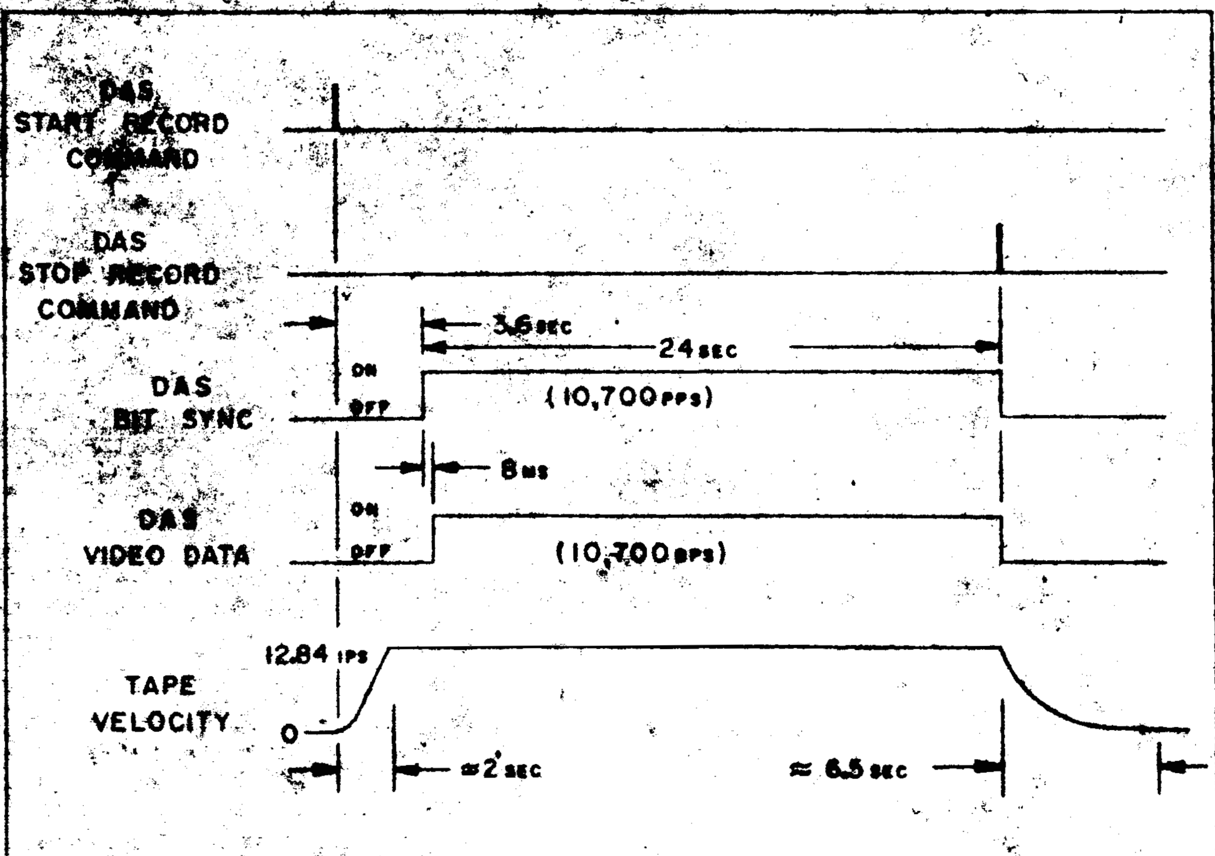

FIGURE 4, PICTURE SEQUENCE TIMING

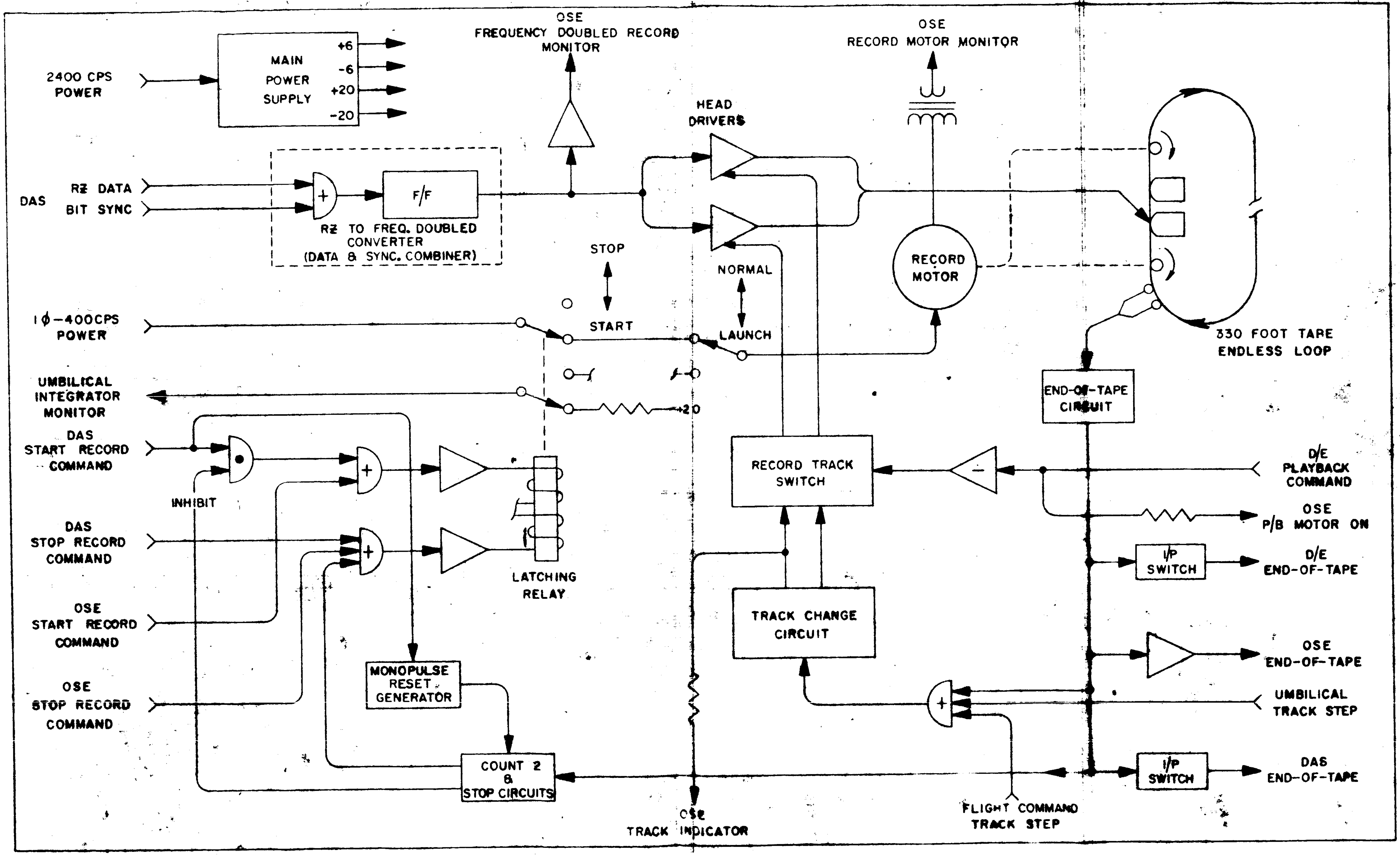

FIGURE 5. RECORD MODE FUNCTIONAL DIAGRAM

7.3 Reproduce Mode (See Figures 6 through 8)

7.3.1 After planetary encounter, once the data have been recorded, the recorder system is switched into the reproduce mode by a command from the Data Encoder. Playback signals are amplified and operated on in such a manner as to reproduce the frequency doubled code waveform that was recorded. Bit sync is separated from the data and compared in phase with the master bit sync from the data encoder. These comparisons determine indirectly the frequency of the voltage controlled oscillator (VCO) which dictates playback tape speed. When the correct speed and phase are achieved, the tape-signal-derived bit sync and the master bit sync are in the proper phase relationship for accurate readout of the data. If a stable phase relation has been established, the recorder system is said to be phase-locked. The reproduce mode may continue indefinitely after encounter, while the system automatically changes tracks once for each pass of the tape. Complete reproduction of twenty picture sequences will require from eight to ten days. Because sections of the tape were erased between record sequences, data will not be present at the output of the system for approximately two hours between picture data blocks. Provision has been made in the recorder system for detecting this condition and automatically switching the Data Encoder from Mode 4 (data playback) to Mode 1 (engineering data).

7.3.2 Passage of the tape over the reproduce head gap produces a signal which is roughly the derivative of the tape flux as indicated in the Reproduce Signal Waveform diagram, Figure 6. This signal, which is in the order of 50 microvolts peak-to-peak, is amplified by low noise preamplifiers located in the tape transport subassembly and routed to the playback track switch and main amplifier. Signals from both tracks are applied simultaneously to the playback track switch where one signal is selected at a time. Output from the main amplifier is available at the OSE by means of a special monitor amplifier.

7.3.3 The peak detector reproduces the recorded frequency doubled waveform. Figure 7 explains the basic operating principle. Peak detection is accomplished by combining the derivative of the playback signal with the selected peaks of the playback signal itself in a coincidence gate which drives one side of a flip-flop. Similar circuitry using the alternate half-cycles drives the other side of the same flip-flop. Push-pull circuitry is used throughout. Note that the playback signal peak amplitude must exceed the threshold level in order to enable the coincidence gate. Output ceases if the peaks do not exceed the threshold setting.

7.3.4 Separation of the bit sync from the frequency doubled code is accomplished in the frequency doubled-to-NRZ converter. This section contains two one-shots and appropriate logic elements which are coupled with a flip-flop necessary to convert the code. Data output from the recorder system is fed to the Data Encoder inverted. Data output is available at the OSE for test purposes.

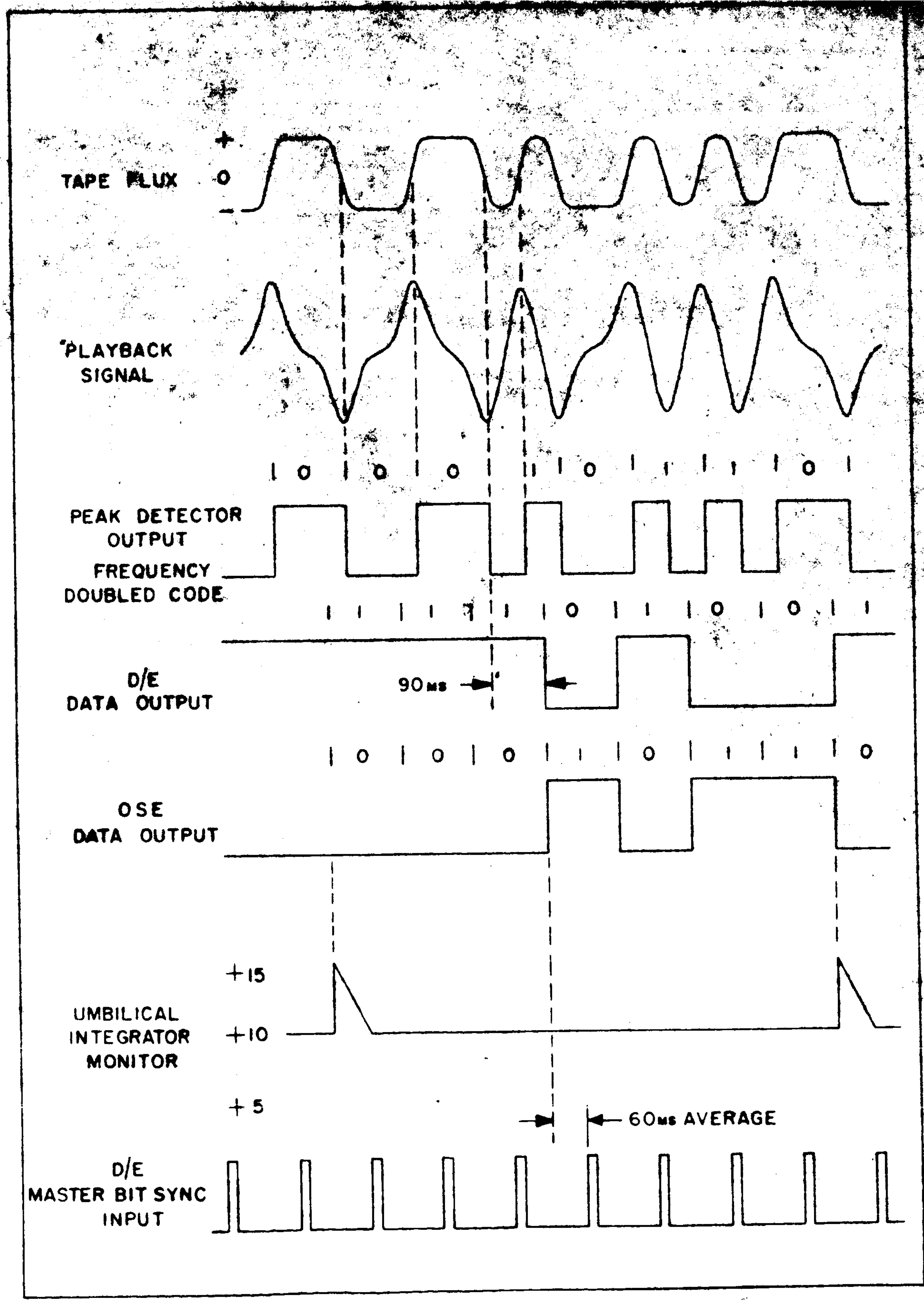

FIGURE 6, REPRODUCE SIGNAL WAVEFORMS

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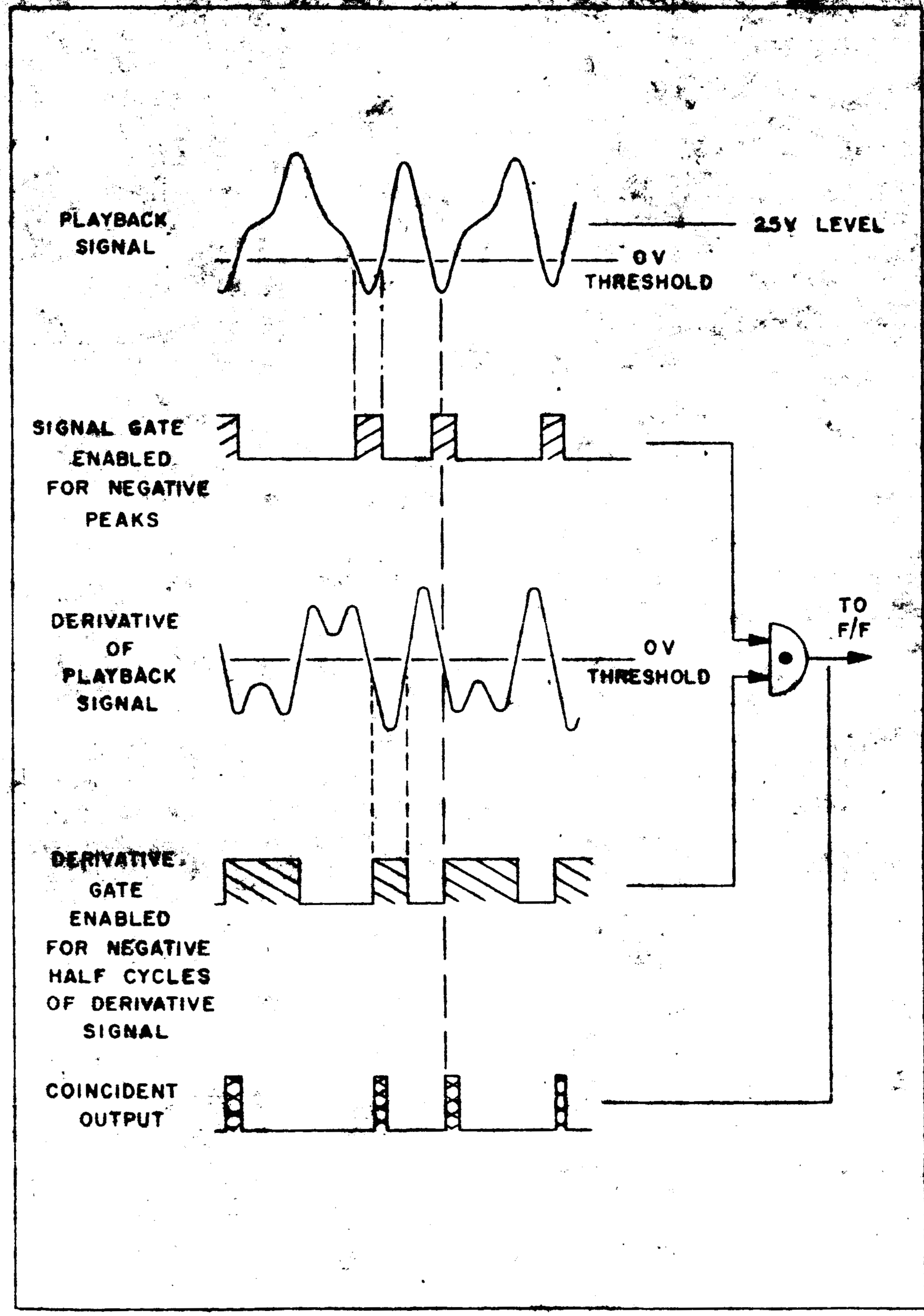

FIGURE 7. BASIC PEAK DETECTION SCHEME

7.3.5 After separation from the frequency doubled code, the slaved bit sync is divided by seven and applied to a phase comparator along with the divided master bit sync from the Data Encoder. By means of the gated integrator circuit, instantaneous phase comparison occurs. As indicated at Figure 6, the integrator waveform follows a reset, rundown, and hold sequence. The holding level is a direct indication of instantaneous phase difference between the divided master bit sync and the divided slave bit sync. During initial lock-up of the system, the gated integrator holding level may vary anywhere from five to fifteen volts. Once the lock is established, variations in holding level rarely exceed two volts peak-to-peak, although a variation of five volts peak-to-peak can occur without loss of lock. The integrator signal is brought out through a special monitor amplifier and the extra contacts of the record-start-stop relay to the spacecraft umbilical interface. Initial phase lock of the system is accomplished in approximately seven phase comparisons.

7.3.6 The gated integrator directly controls the frequency of a voltage controlled oscillator (VCO) whose output is divided and applied by means of a power amplifier to the playback motor. The VCO has a nominal center frequency of 1512 cps, deviating plus or minus eight per cent for a ten volt variation in the gated integrator output. A center frequency adjustment, located on subchassis 16A3, is provided to compensate for tolerances in the over-all recorder system. Because playback motor drive voltage requirements may vary from one tape transport subassembly to the next, it may be necessary to vary the supply voltage applied to the playback motor power amplifier. This adjustment is located on subchassis 16A4. A playback command from the Data Encoder enables the playback motor power amplifier. Absence of this command signal inhibits the playback motor power amplifier and, as noted previously, switches the system into the record mode.

7.3.7 Each complete pass of the tape loop generates an end-of-tape pulse as the EOT foil passes over sensor contacts. As in the record mode, the EOT pulse is applied to the track change circuits and is also fed out to an event counter in the Data Encoder. In addition, the EOT pulse is brought out to the OSE.

7.3.8 The track change circuit determines which preamplifier signal is applied to the main amplifier. A track change may be triggered by an end-of-tape pulse, a track step command from the spacecraft umbilical, or a track step command from the Flight Command Subsystem.

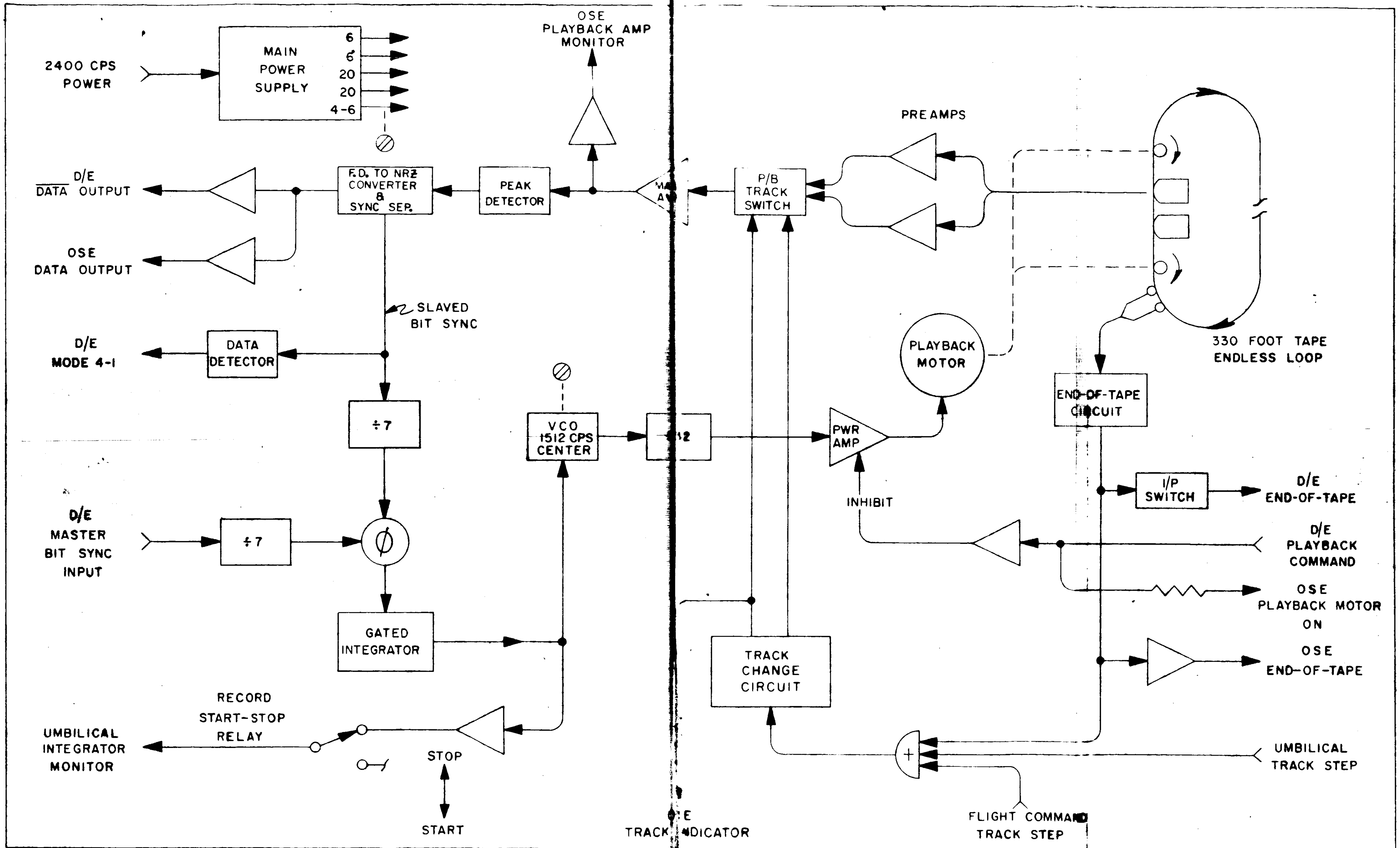

FIGURE 8, REPRODUCE MODE FUNCTIONAL DIAGRAM

7.4 Temperature and Pressure Transducers

7.4.1 The temperature of the main mounting plate of the tape transport subassembly is measured by means of a temperature transducer which is monitored for telemetry purposes by the Data Encoder. Expected temperatures of the case in which the Video Storage Subsystem is mounted are indicated in Figure 9. Temperature transducer indications may be expected to lag behind case temperatures considerably due to the inherent thermal isolation of the main mounting plate.

7.4.2 The tape transport subassembly 16A1, is a hermetically sealed unit. Verification of proper seal is obtained by telemetering the output of a pressure transducer mounted within the transport case. A gradual pressure loss is expected because of molecular diffusion of gas through the seal elastomer. The leak rate due to molecular diffusion is directly proportional to temperature and the pressure difference across the seal. Thus it is difficult to predict accurately pressure changes versus time; however, Figure 10 depicts an expected worst-case plot.

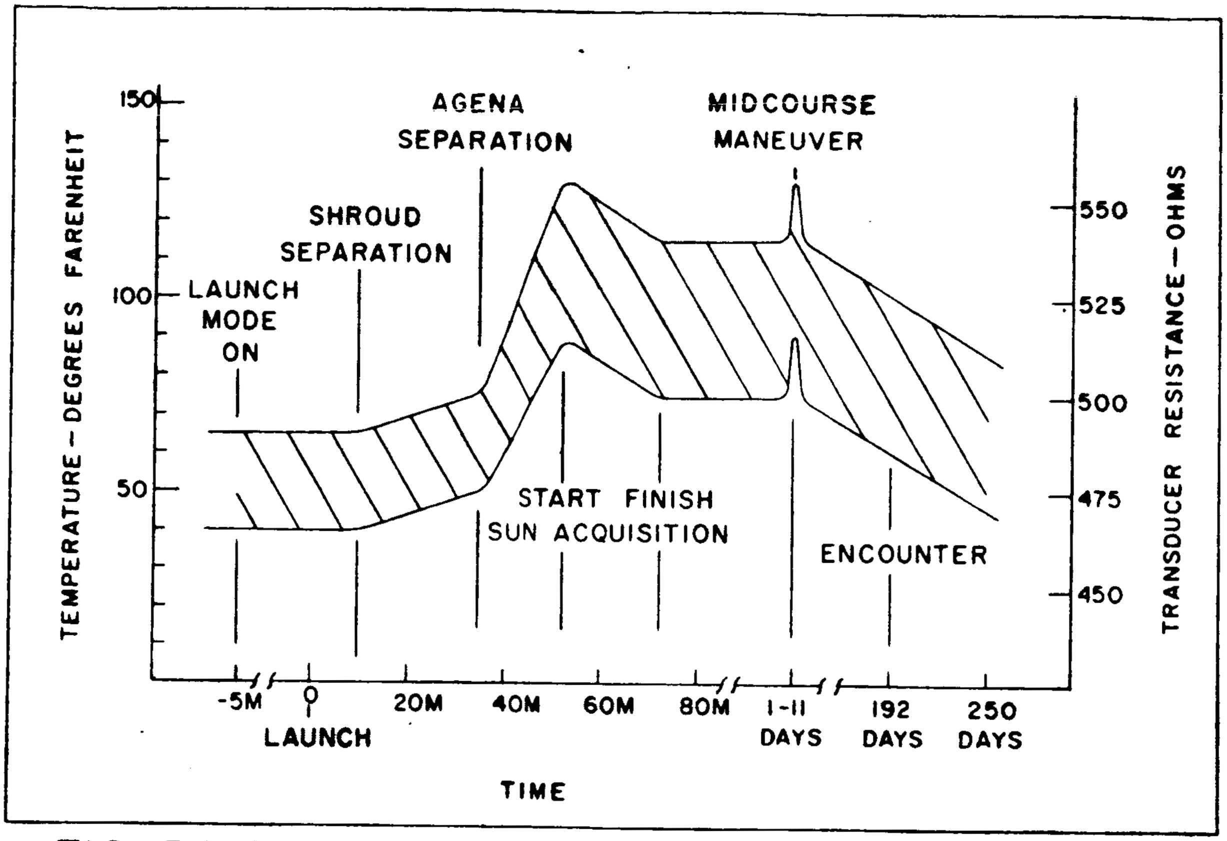

FIGURE 9. TEMPERATURE TRANSDUCER

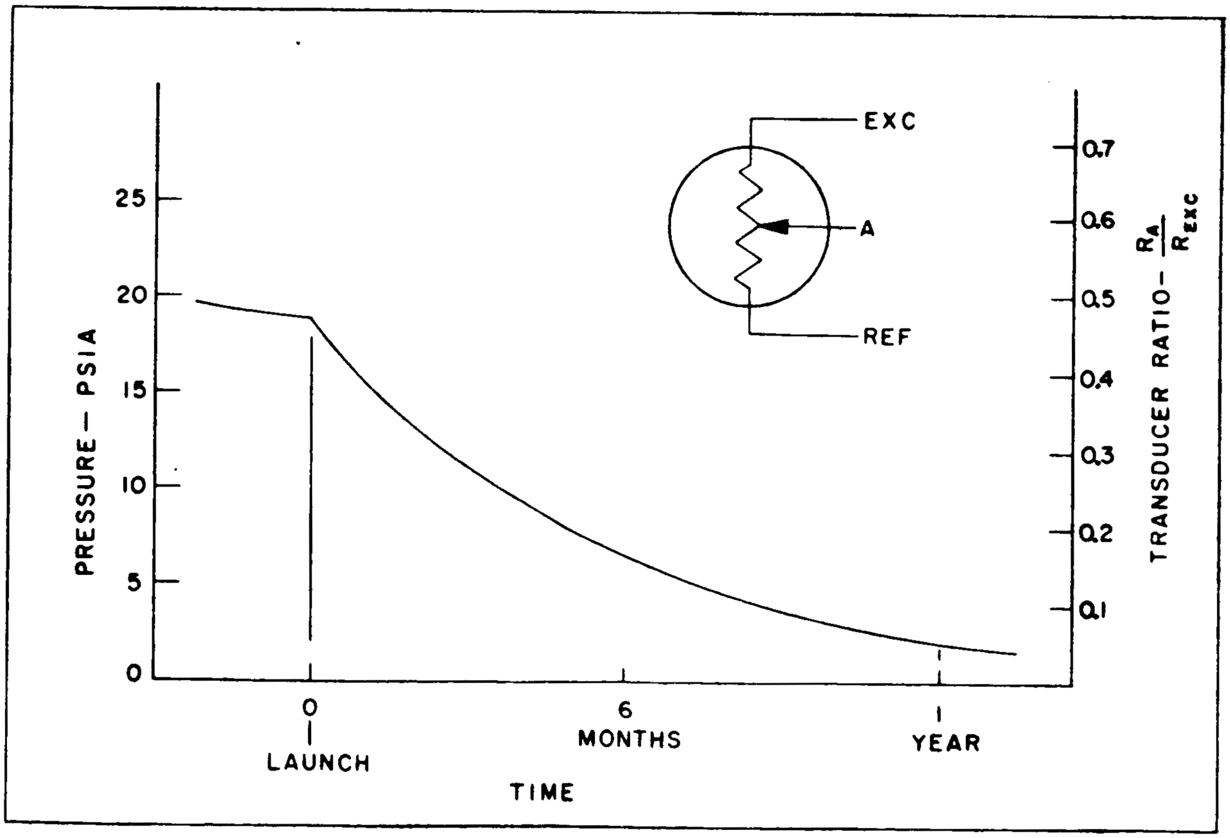

FIGURE 10. PRESSURE TRANSDUCER

8.0 FUNCTIONAL INTERFACES

8.1 Launch Mode

8.1.1 Spacecraft Gyro Power- Phase AB of a three phase source is used. Approximately 0.2 watts is dissipated in the transformer/rectifier unit; 3.5 watts is used when the record motor is running. Motor starting surge may approach 7 watts for 1 or 2 seconds.

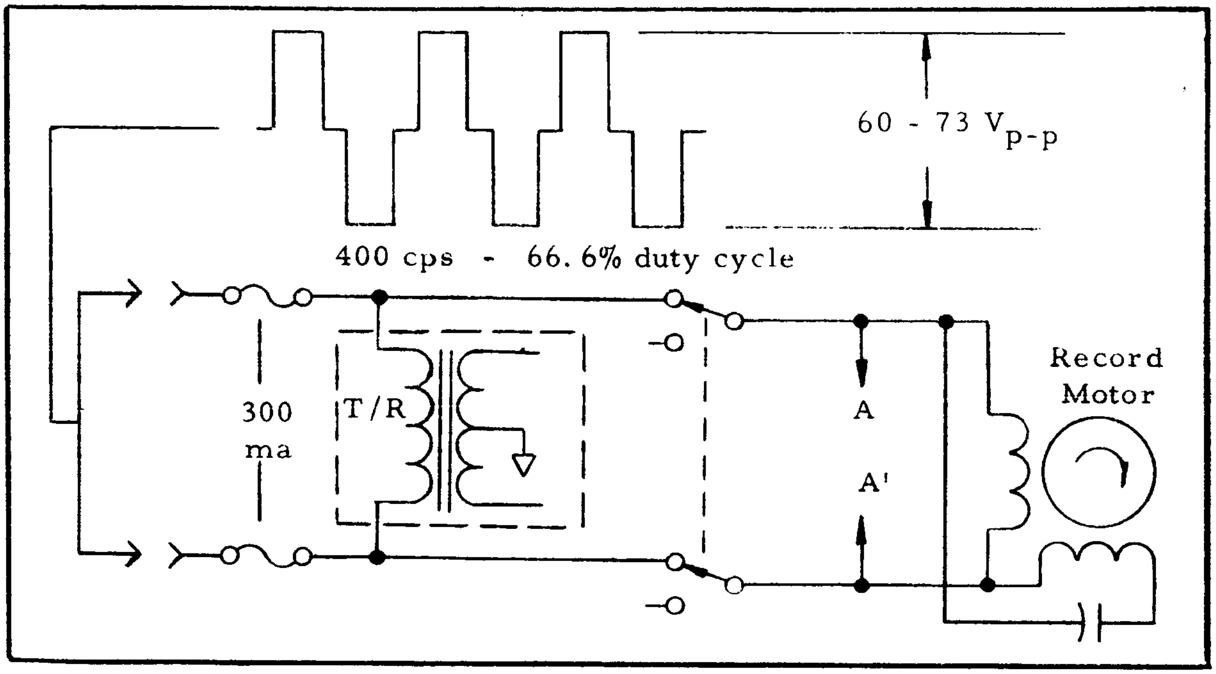

Figure 11, Gyro Power

8.1.2 Umbilical Launch Mode Control- pulses applied to set or reset launch mode latching relay. A threshold detector measures resistance by feeding a small monitor current through the solenoid and resistor combination.

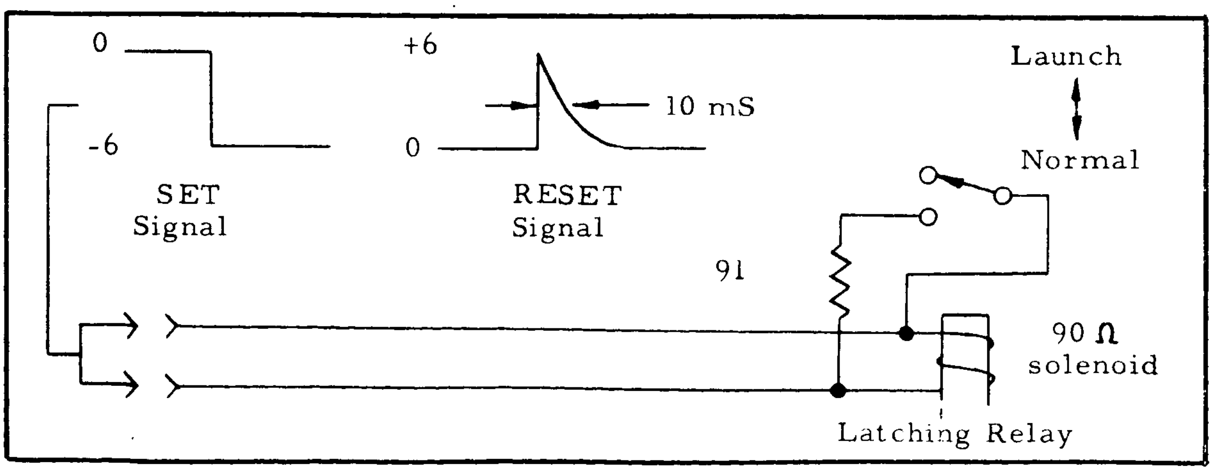

Figure 12, Launch Mode Control

8.1.3 Umbilical Agena Separation Signal- filtering used to minimize effects of separation connector contact bounce during launch. System common fuzed to protect from ground loop conditions if umbilical connector shorts.

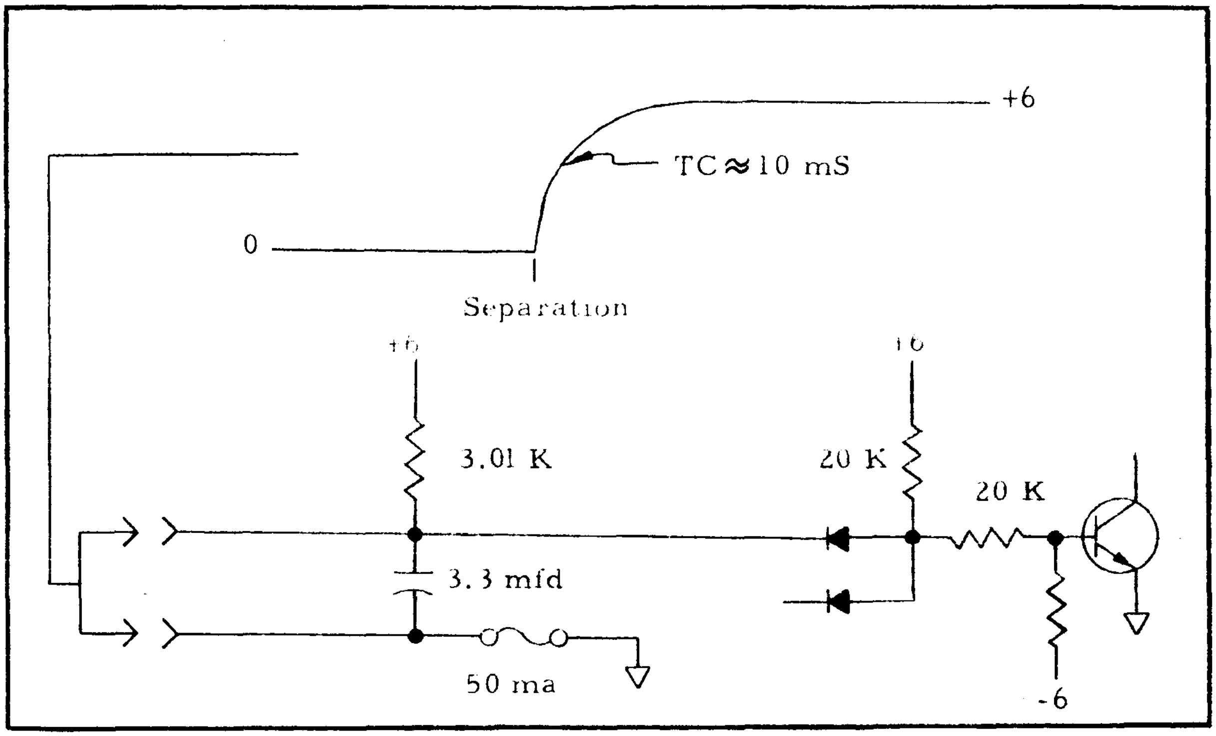

Figure 13, Agena Separation Signal

8.1.4 OSE Record Motor Monitor - transformer isolated signal appearing across record motor. Signal distortion due to transformer. Operates the running time indicator and relay in the OSE.

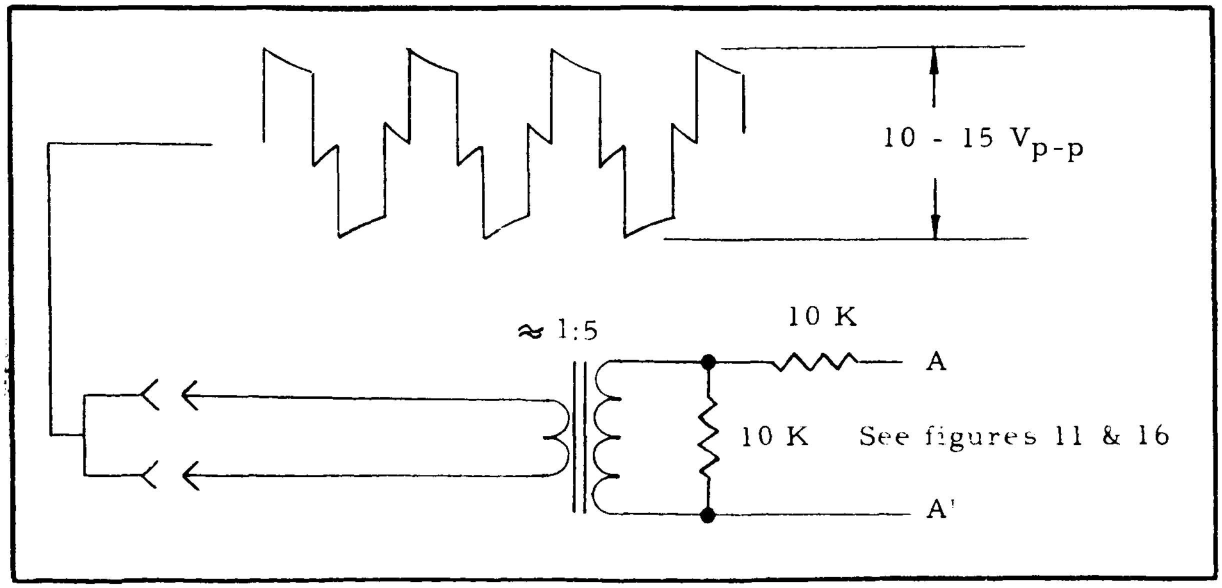

Figure 14, Record Motor Monitor

8. 2 Record Mode

8. 2. 1 Spacecraft 2400 cps Power - main power source for the recorder system. Power consumption in the record mode is approximately 3 watts. In-rush current on application of power limited to 1-1/2 times the maximum load current.

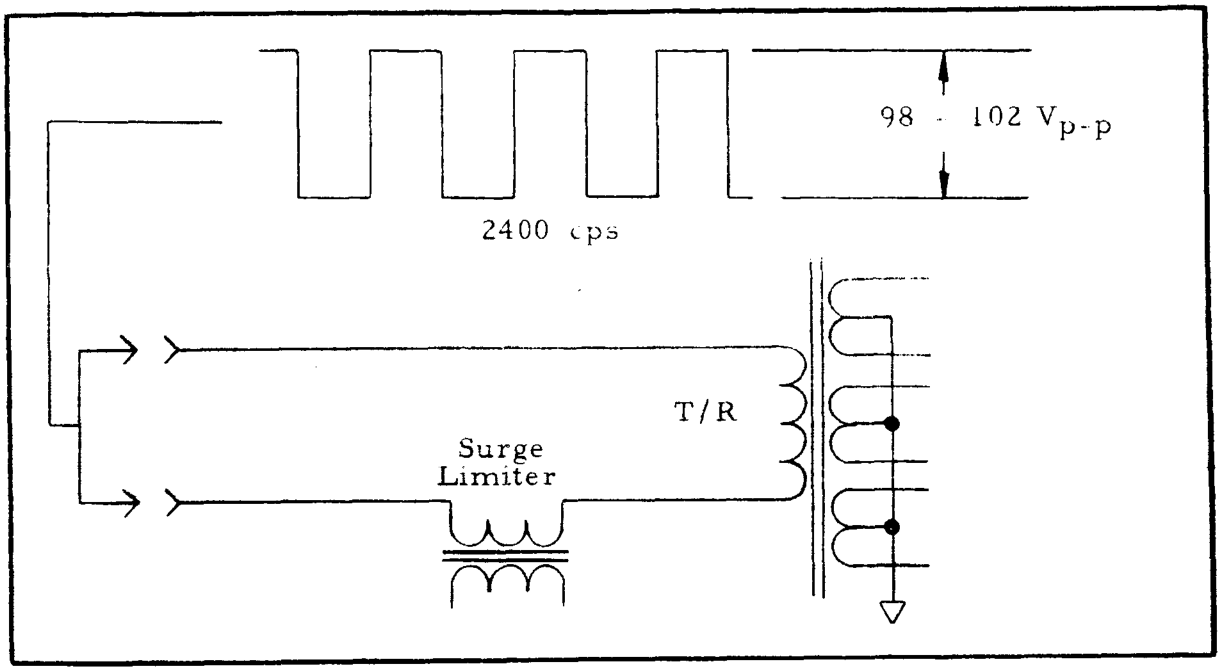

Figure 15, 2400 cps Power

8. 2. 2 Spacecraft 400 cps Single Phase Power - operates record motor during encounter phase. Approximately 4.5 watts is consumed when the record motor is running synchronously, 8 watts during starting surge.

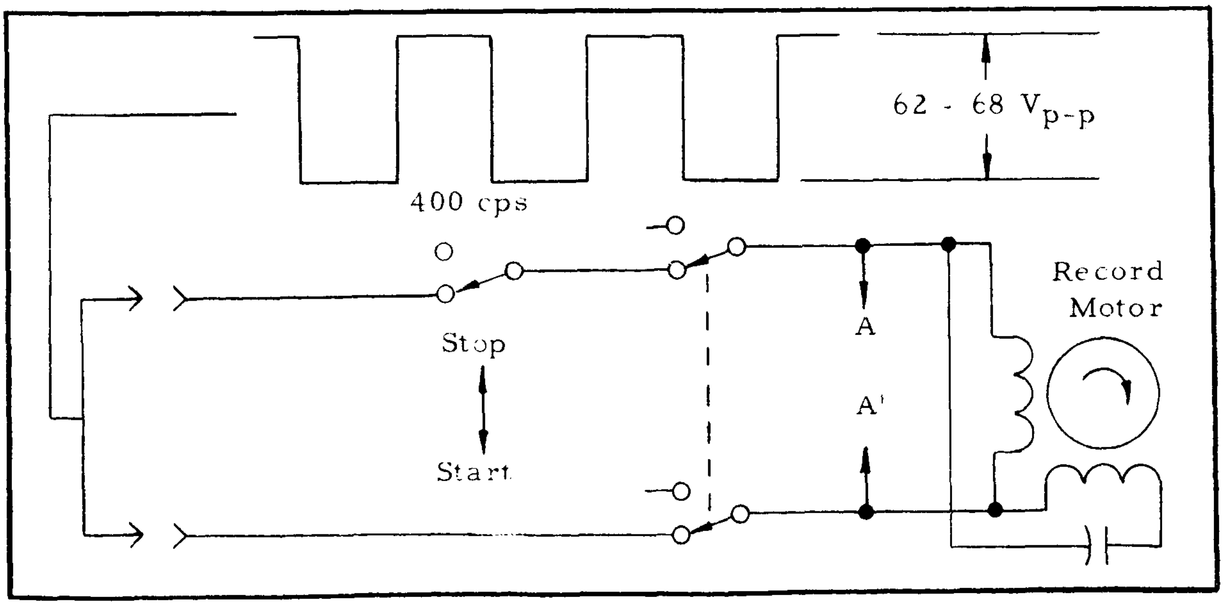

Figure 16, 400 cps Power

8.2.3 DAS RZ Data and Bit Sync- encounter data and sync signals, transformer coupled from the Data Automation Subsystem.

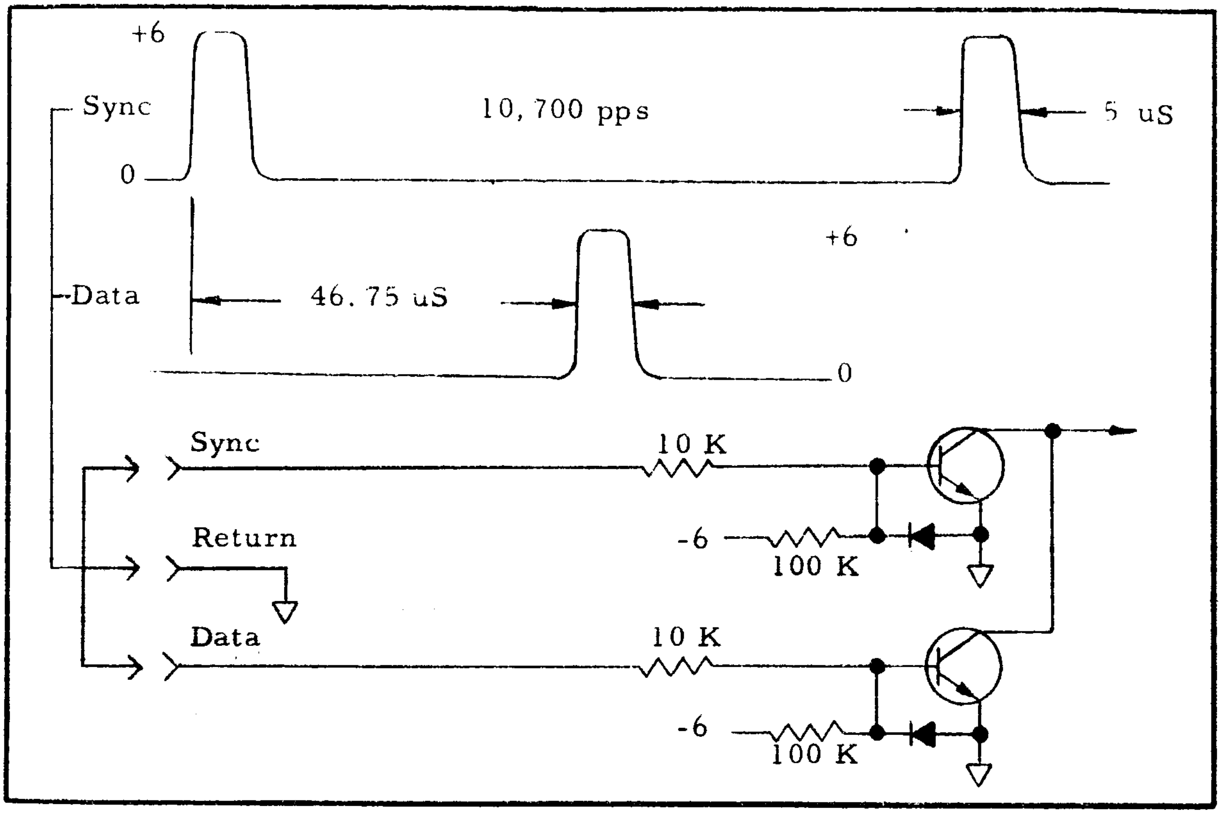

Figure 17, DAS Data and Sync

8.2.4 DAS Start Record Command- energizes record-start-stop relay to initiate a record sequence.

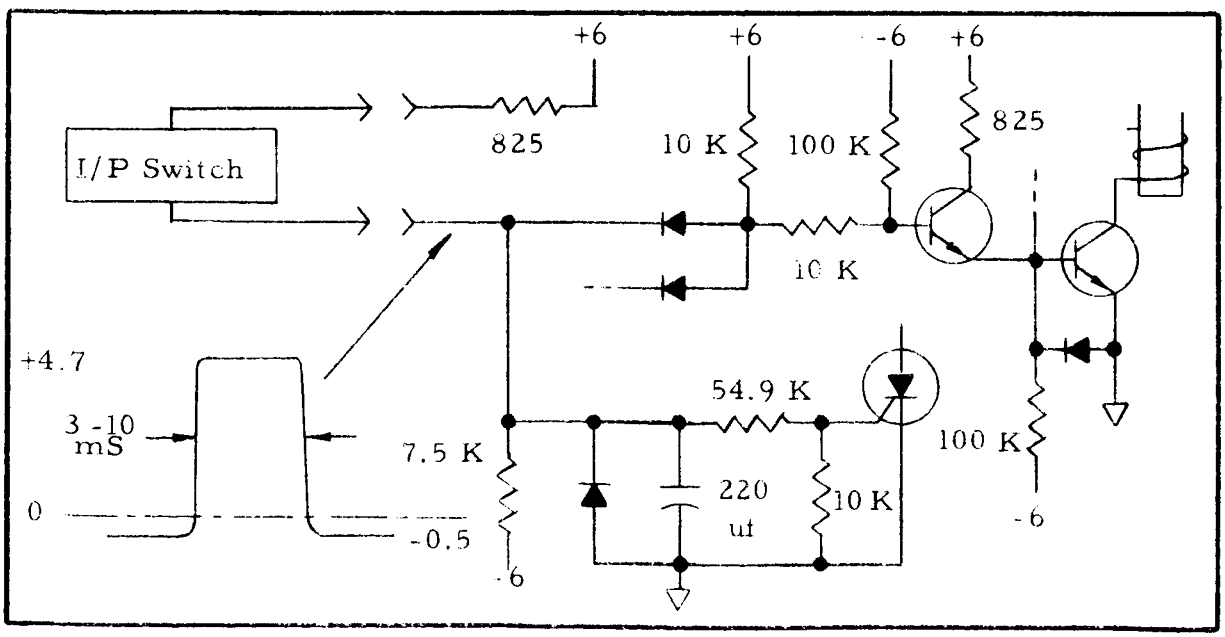

Figure 18, DAS Start Command

8.2.5 DAS Stop Record Command- de-energizes the record start stop relay to terminate a record sequence.

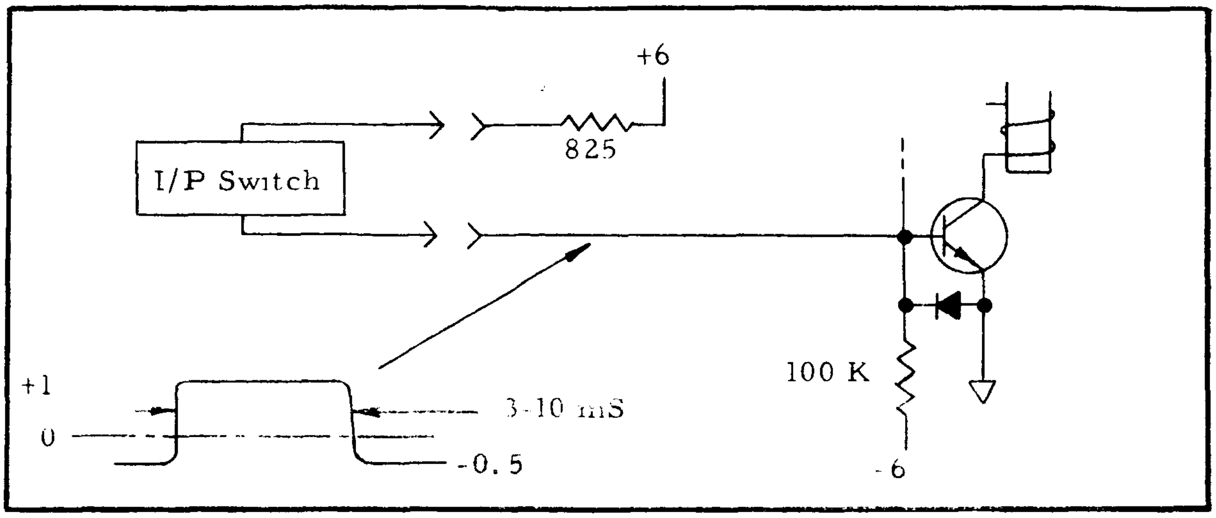

Figure 19, DAS Stop Command

8.2.6 OSE Start Record Command- energizes record start stop relay for test purposes.

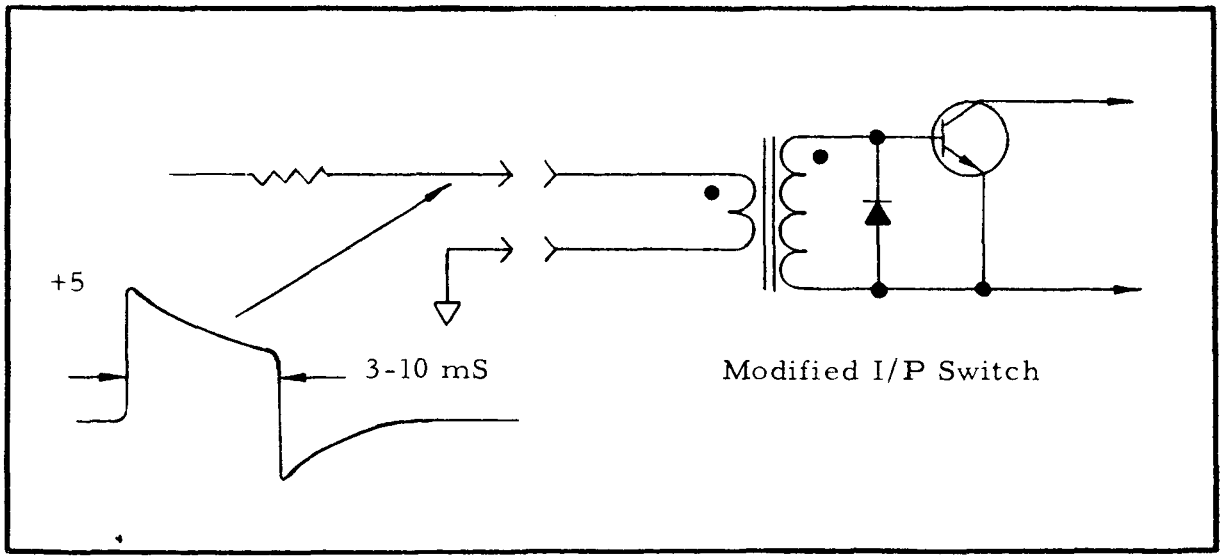

Figure 20, OSE Start/Stop Commands

8.2.7 OSE Stop Record Command- de-energizes record start stop relay for test purposes. Interface is the same type as that used for OSE Record Start Command; see Figure 20.

8.2.8 Umbilical Integrator Monitor - in record mode, indicates whether the record start stop relay is in the start or stop position.

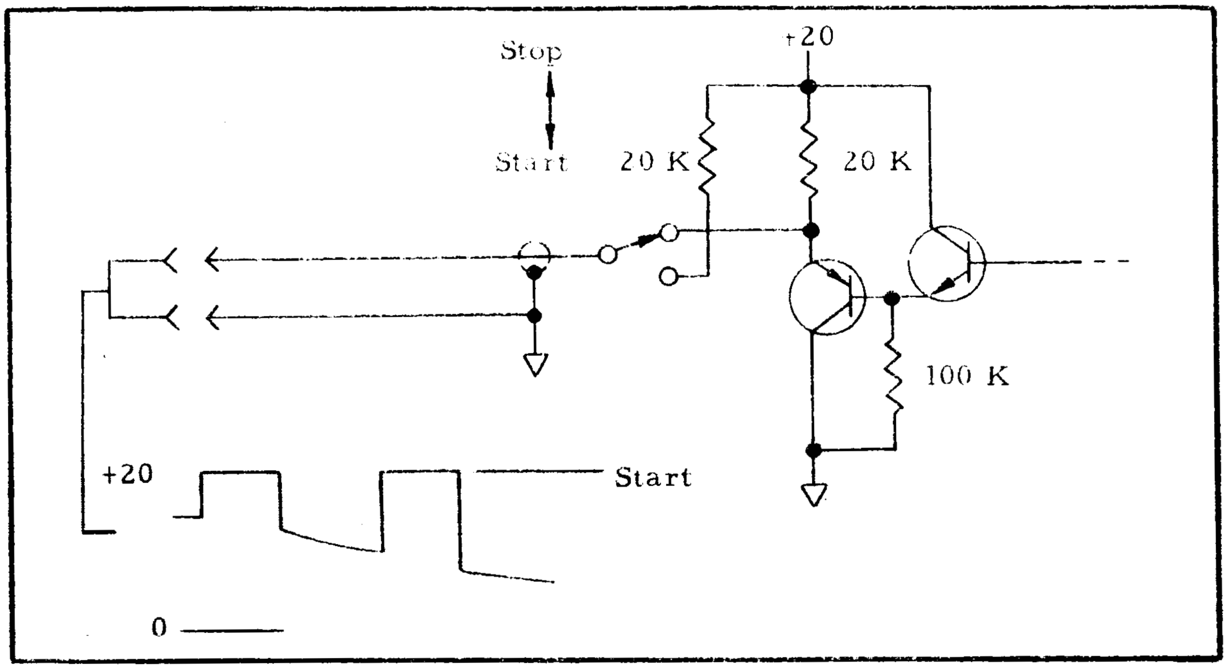

Figure 21. Integrator Monitor

8.2.9 OSE Frequency Doubled Record Monitor - monitor point to determine proper conversion from RZ to the frequency doubled code and to ascertain the presence of data inputs to the recorder system during test.

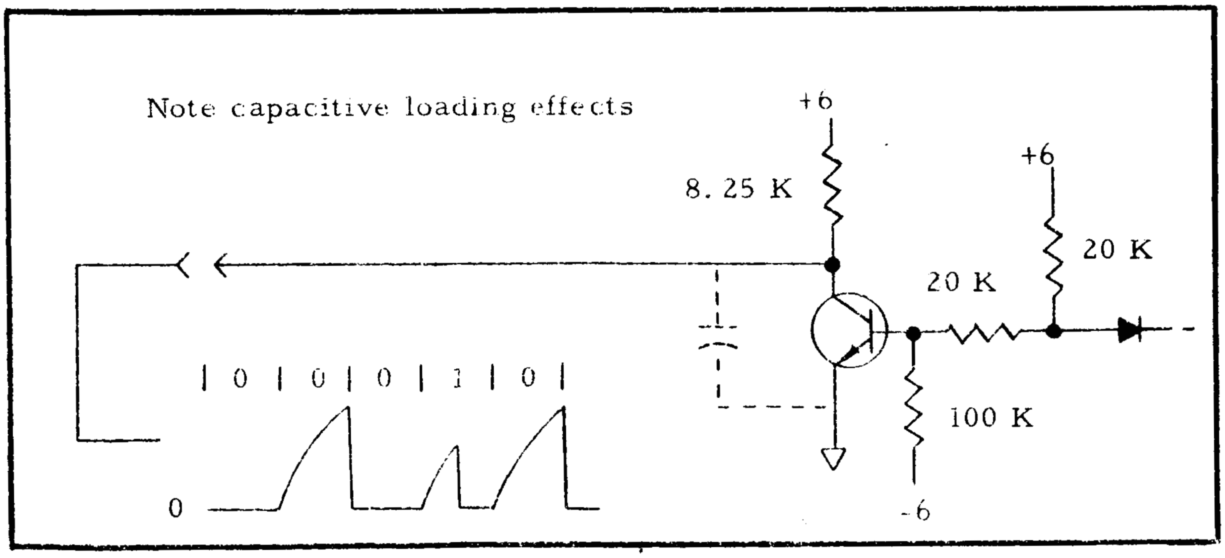

Figure 22. F. D. Record Monitor

8.2.10 OSE Record Motor Monitor - transformer isolated presentation of the voltage waveform appearing across the record motor. Distortion is caused by transformer action. Performs the same function as in launch mode operation; see Figure 14 for interface diagram.

8.2.11 OSE Track Indicator - operates indicating relay in the OSE to facilitate test.

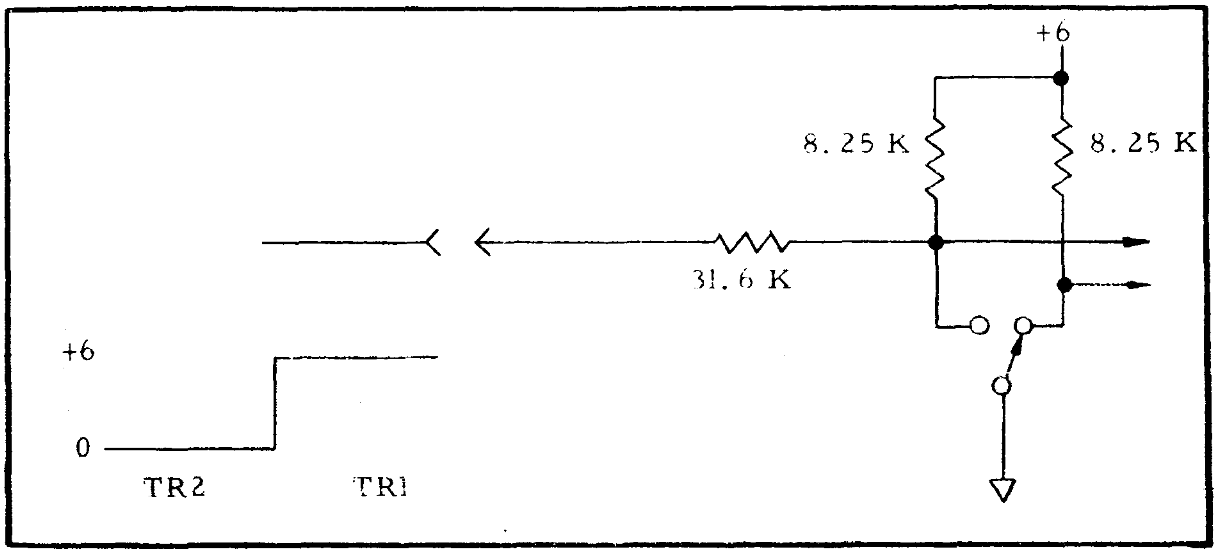

Figure 23, Track Indicator

8.2.12 D/E Playback Command - controls the operational mode of the recorder system. See Figure 32 for interface diagram.

8.2.13 OSE Playback Motor ON - operates playback relay, indicator lights, and elapsed time meter in the OSE for test purposes. Figure 33 defines the interface circuit.

8.2.14 D/E End-of-Tape- operates Event Counter Number 3 in the Data Encoder Subsystem.

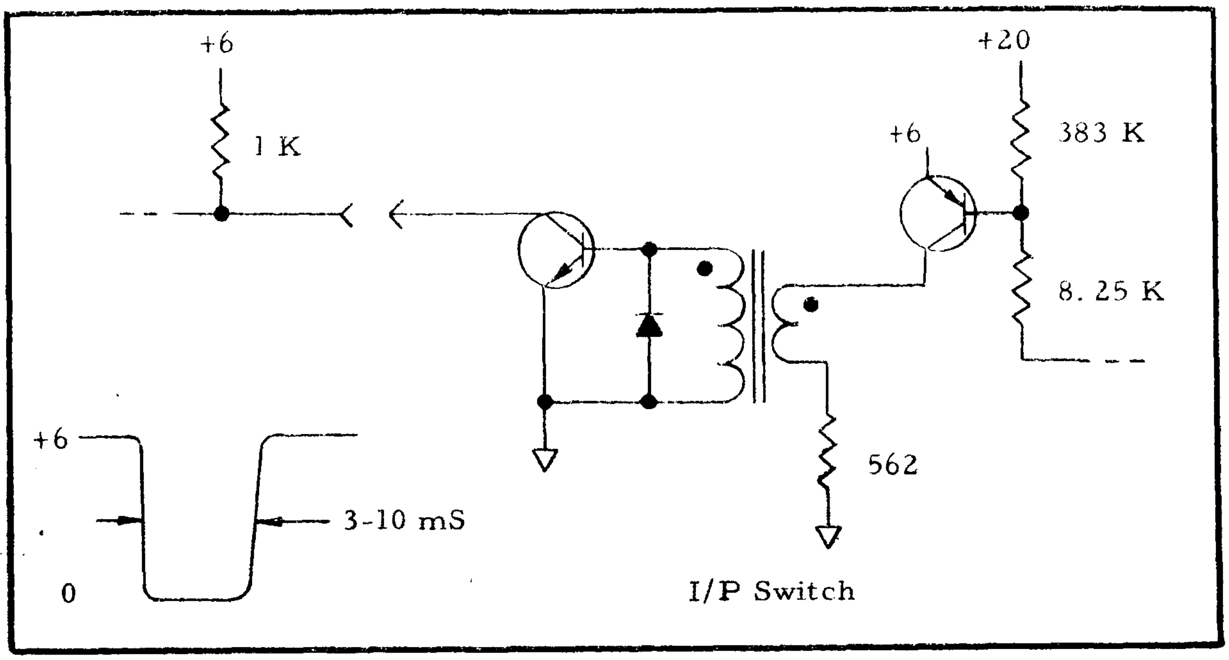

Figure 24, D/E End-of-Tape

8.2.15 DAS End-of-Tape- end-of-tape signals sent to the Data Automation Subsystem to terminate the encounter recording sequences.

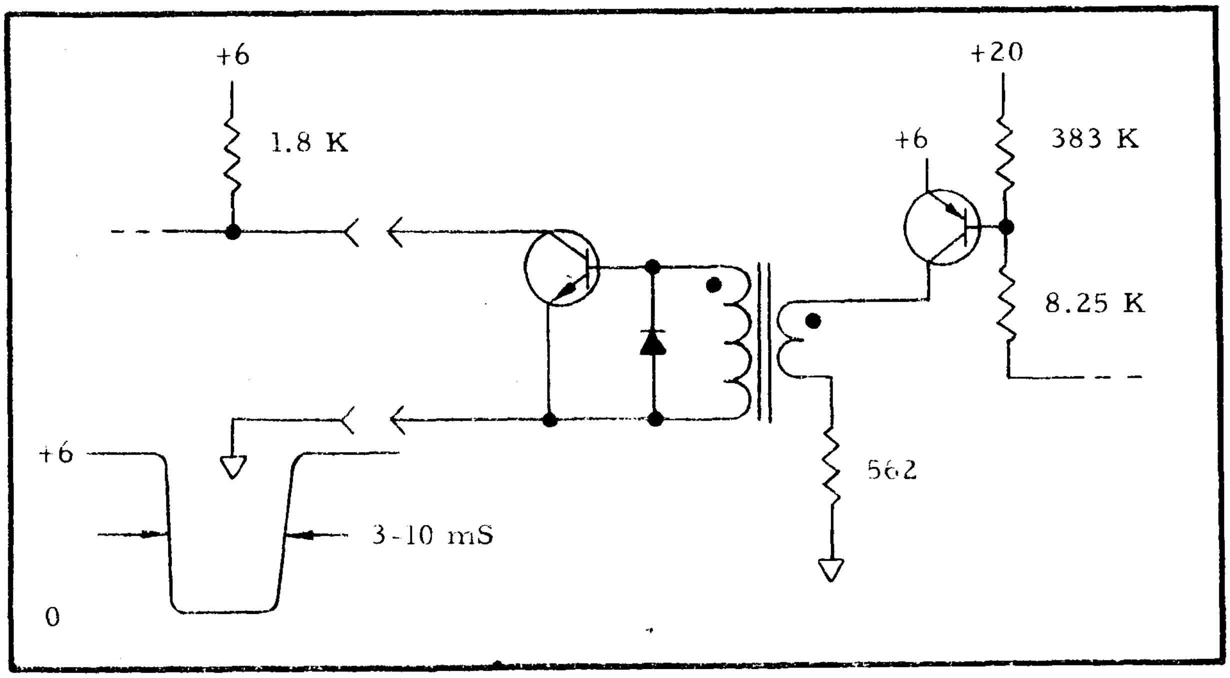

Figure 25, DAS End-of-Tape

8.2.16 OSE End-of-Tape- operates the automatic stop circuits of the OSE when it is desired to index the tape loop to the beginning position.

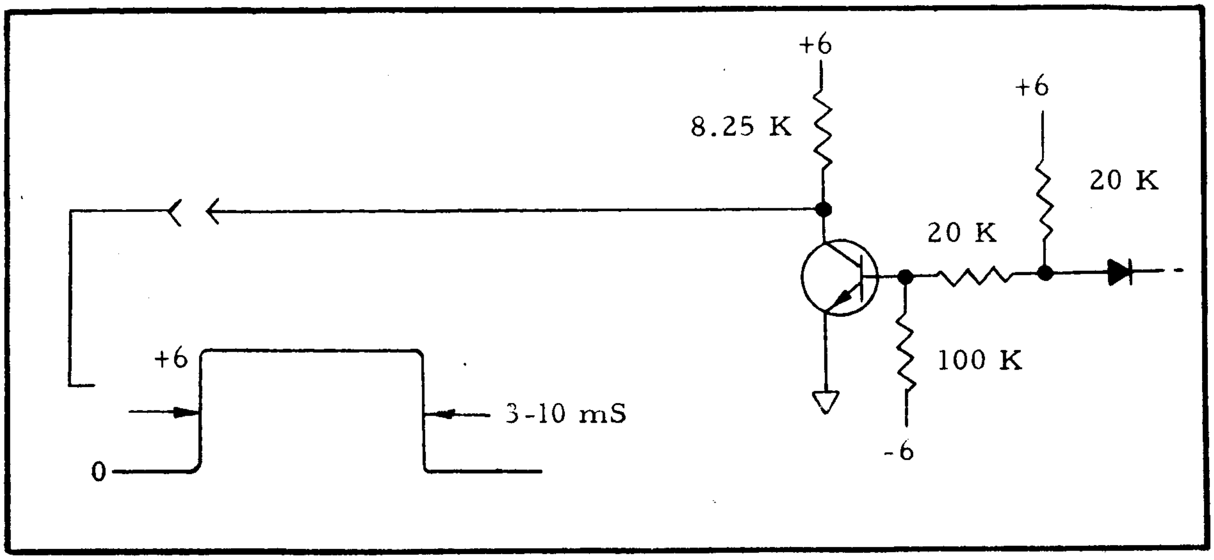

Figure 26, OSE End-of-Tape

8.2.17 Umbilical Track Step Command- enables verification and test of both tracks of the recorder system without the necessity of completing an entire pass of the tape loop.

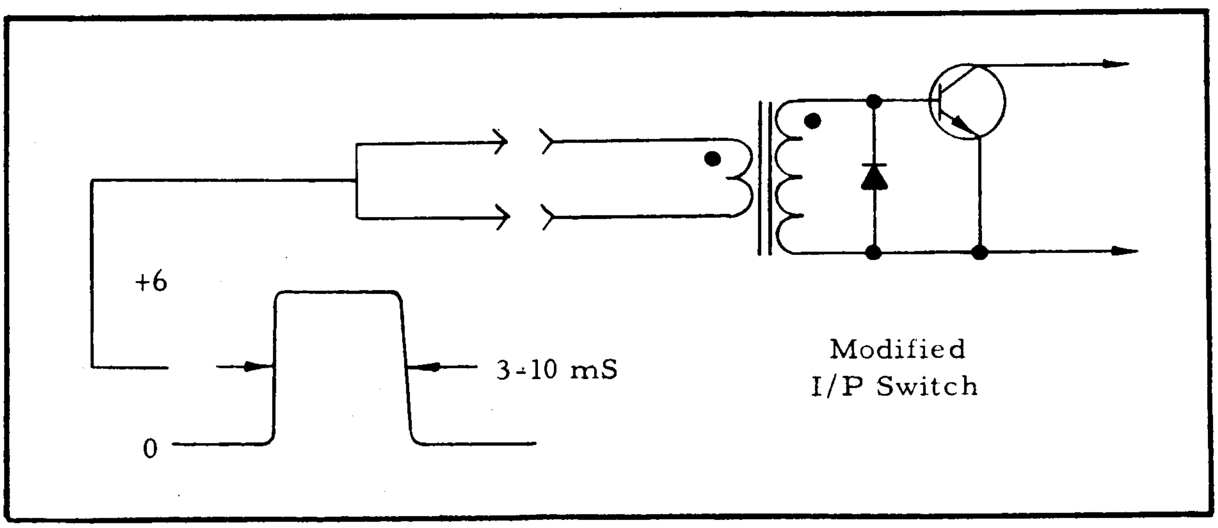

Figure 27, Umbilical Track Step

8.2.18 Flight Command Track Step- The function of this command is to allow changing tracks while reproducing data after planetary encounter. It would not normally be used during encounter recording sequences. See Figure 34 for interface.

8.3 Reproduce Mode

8.3.1 Spacecraft 2400 cps Power - This is the same power supply indicated in the record mode functional interface. An additional function is incorporated in the form of an adjustable 4-6 volts supply for the playback motor drive amplifier. Approximately 4 watts is consumed in the reproduce mode. See Figure 15 for interface diagram.

8.3.2 OSE Playback Amplifier Monitor - For test purposes the playback signal out of the main amplifier is brought to the OSE through a special interfacing amplifier. See Figure 28 for signal waveform.

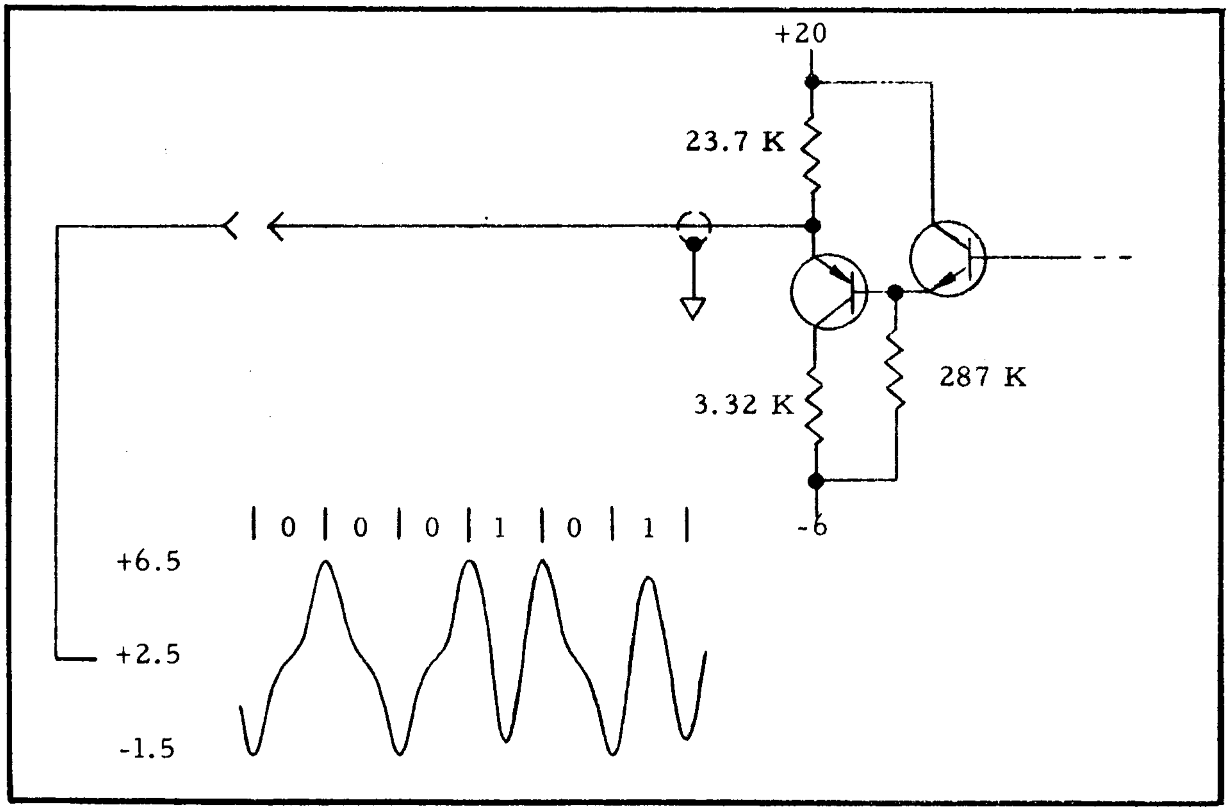

Figure 28, Playback Amplifier Monitor

8.3.3 D/E Data Output - NRZ data fed to the data encoder during reproduce mode operation. A typical signal waveform is depicted in Figure 29.

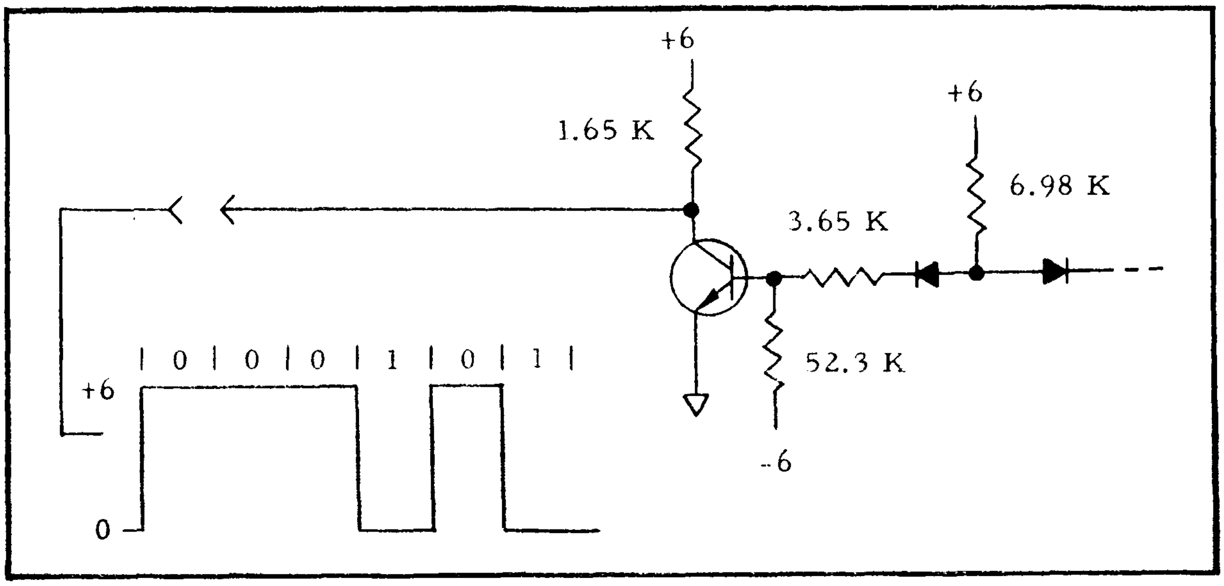

Figure 29, D/E Data Output

8.3.4 OSE Data Output- Data output from the recorder system is made available at the OSE for test purposes. The interface circuit is the same type used for the D/E data output shown in Figure 29 although the output signal is of the opposite phase.

8.3.5 D/E Master Bit Sync Input - Bit sync pulses from the data encoder are used as a reference by the recorder system while reproducing the data.

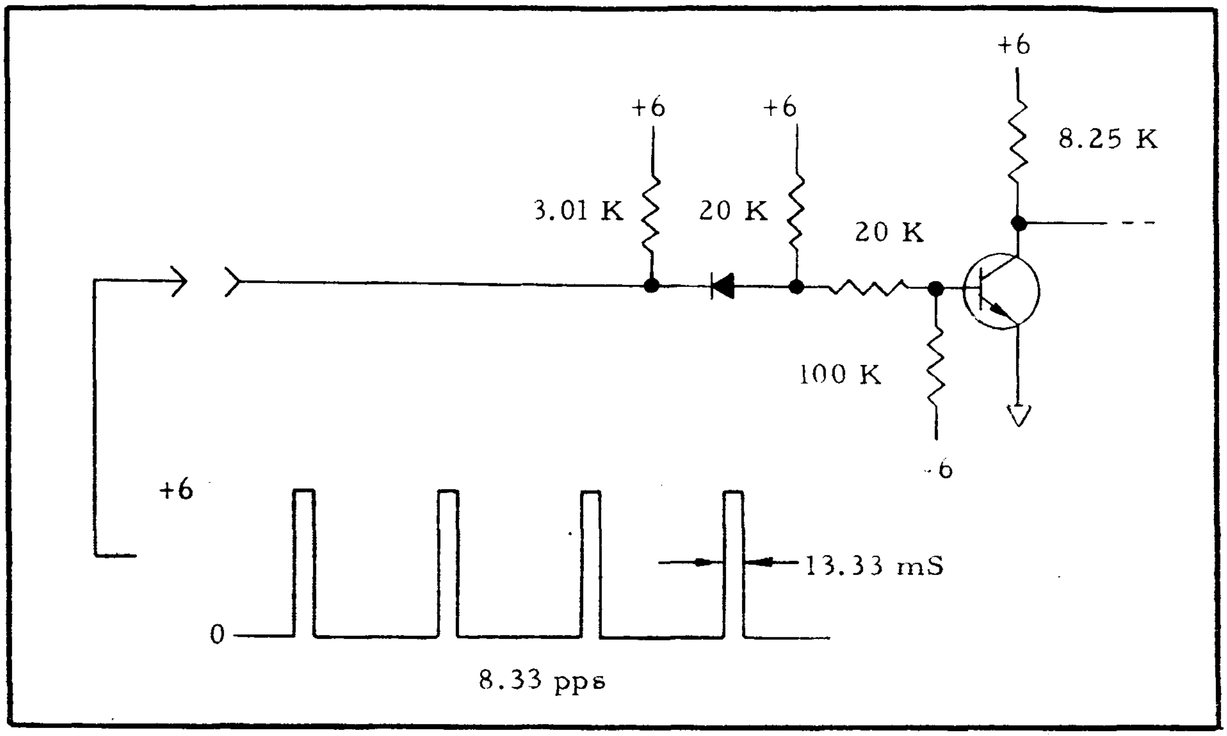

Figure 30, D/E Bit Sync Input

8.3.6 Umbilical Integrator Monitor - Gated integrator signals are brought out through the spacecraft umbilical as a means of evaluating the recorder system performance after installation of the spacecraft in the carrier rocket. The signal waveform is shown in Figure 31.

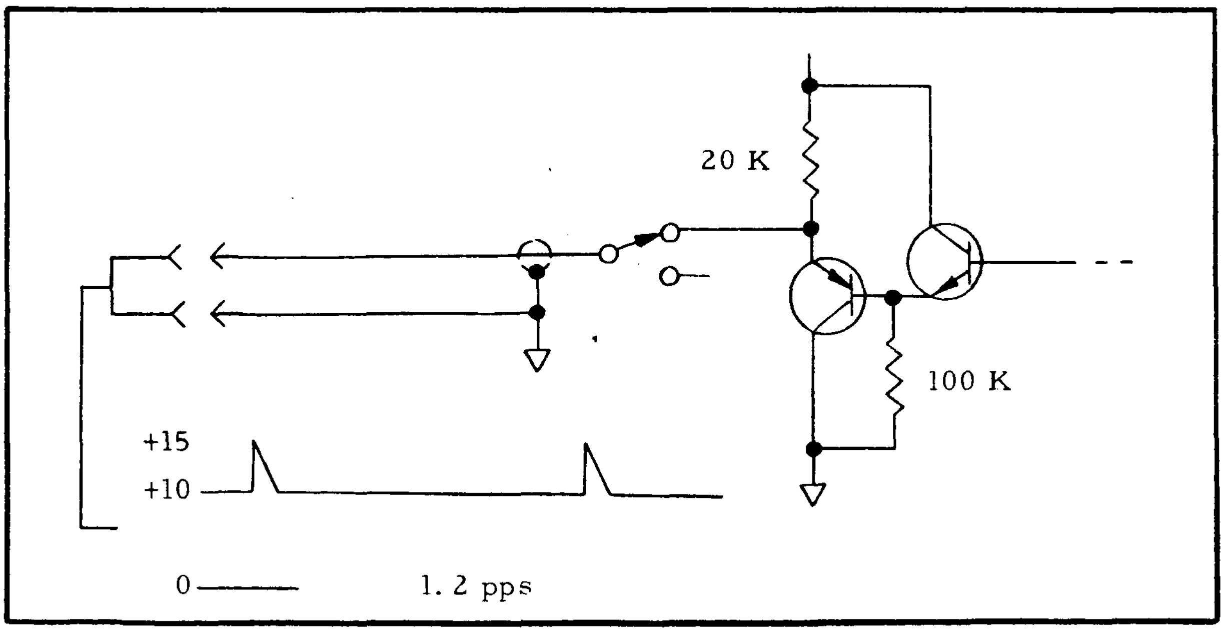

Figure 31, Integrator Monitor

8.3.7 OSE Track Indicator- The track indicator line performs the same function in the reproduce mode as in the record mode. See Figure 23 for the interface.

8.3.8 D/E End-of-Tape - End-of-tape signals are coupled to the event counter in the Data Encoder Subsystem as in the record mode. Figure 24 depicts the interface.

8.3.9 OSE End-of-Tape- This signal is available at the OSE for test purposes although no function is performed when operating in the reproduce mode. See Figure 26 for interface diagram.

8.3.10 D/E Playback Command- enables the playback motor power amplifier and disables record circuits as noted in the record mode operational description.

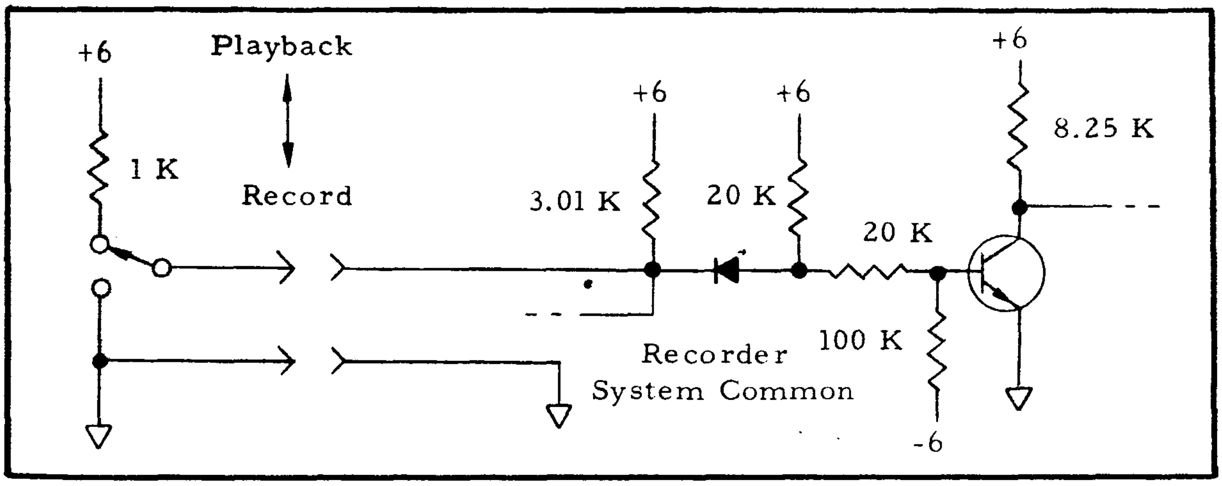

Figure 32, D/E Playback Command

8.3.11 OSE Playback Motor On Signal- operates a relay, indicator light, and running time meter in the OSE.

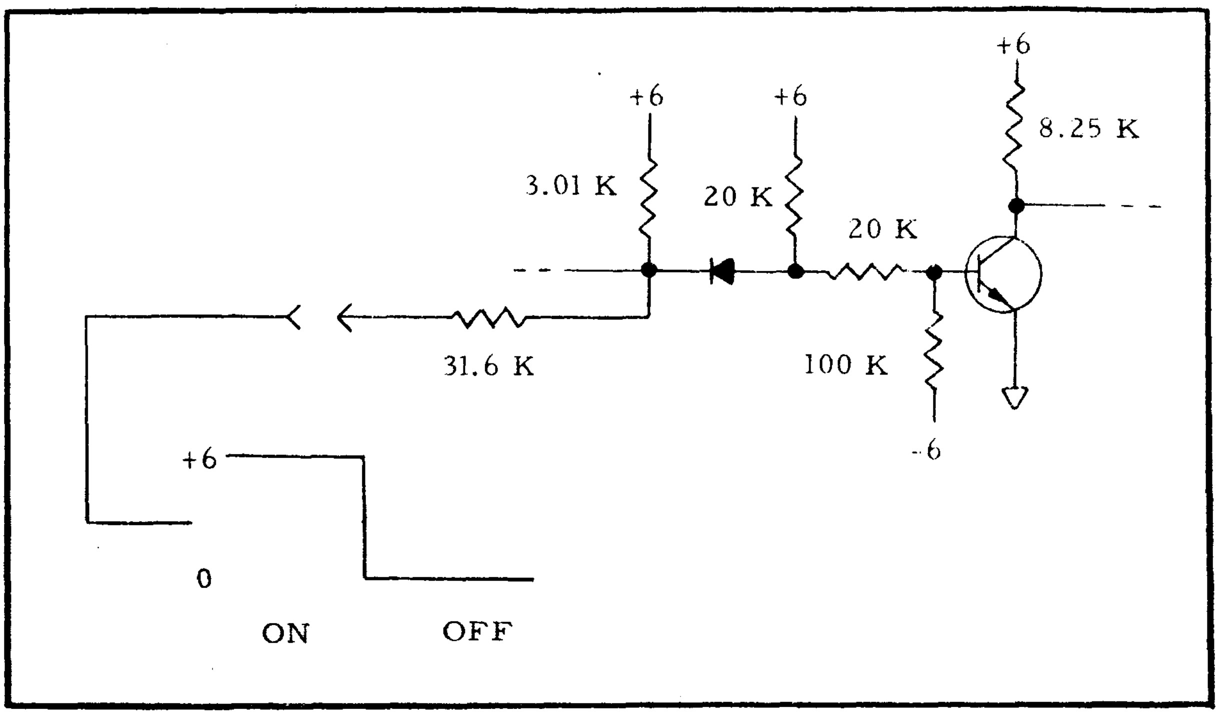

Figure 33, OSE Playback Motor On

8.3.12 Umbilical Track Step Command- performs the same function as in record mode. See Figure 27.

8.3.13 Flight Command Track Step- allows changing from one track to the other when reproducing data after planetary encounter.

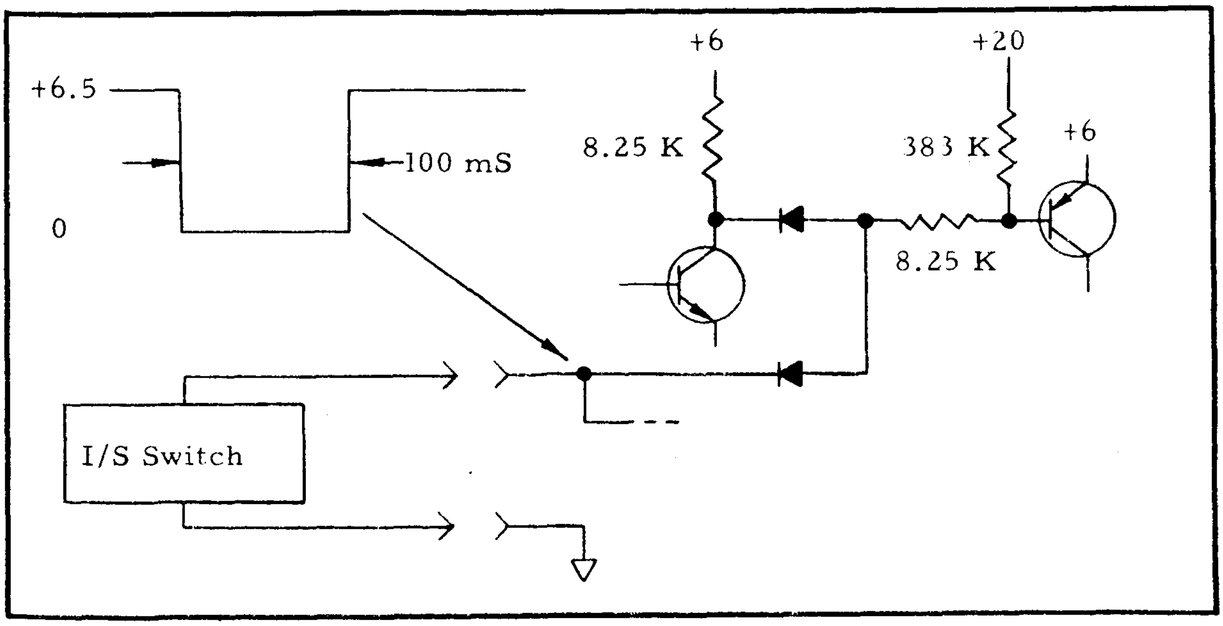

Figure 34, Flight Command Track Step

8.3.14 <u>Mode 4-1 Logic Signal</u>- data detector output signal; switches Data Encoder from Mode 4 to Mode 1 when operating over erased tape between picture sequences.

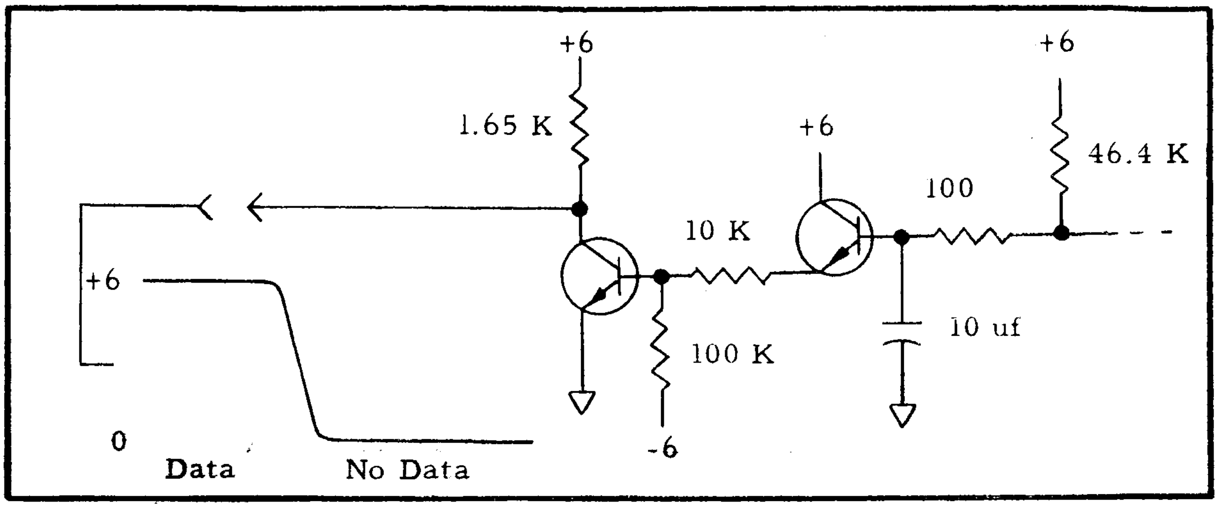

Figure 35, Mode 4-1 Logic Output

9.0 OTHER INTERFACES

9.1 Monitor points for the various 2400 cps power supplies have been brought out to the OSE for test purposes. No specific functional requirement is attached to these interfaces. They are included as a means of evaluating power supply performance and to facilitate adjustment of the playback motor drive amplifier supply voltage.

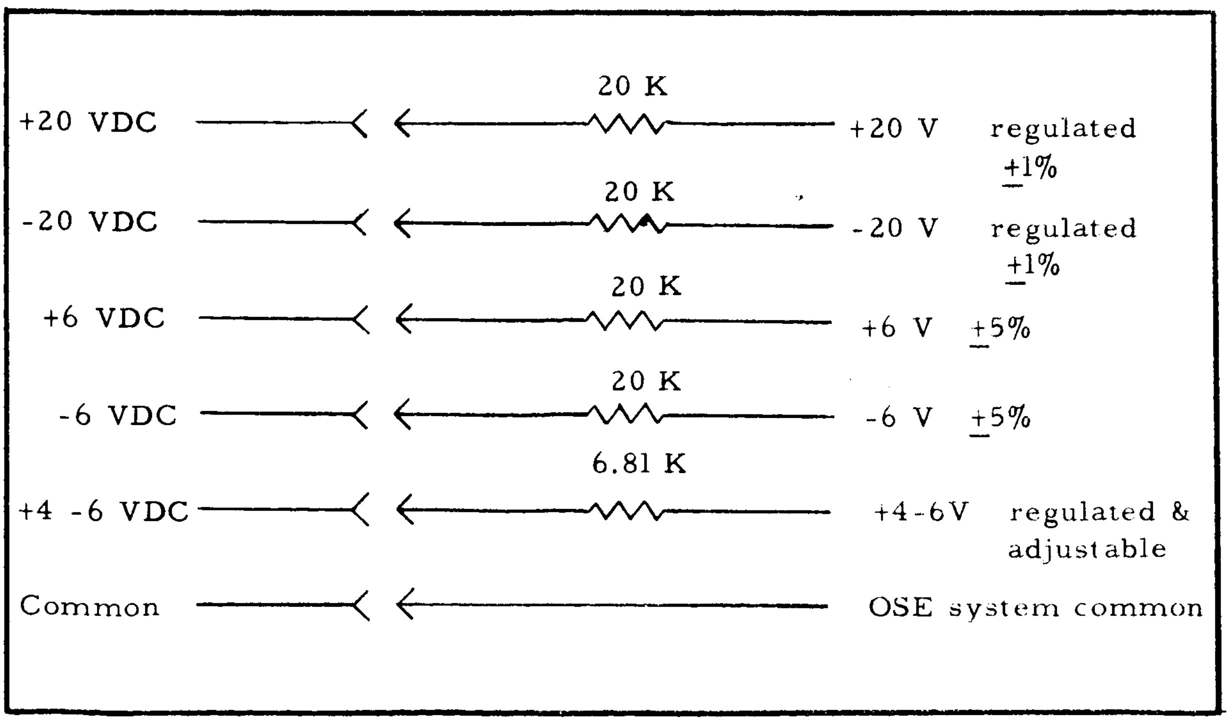

Figure 36, Power Supply Monitors

9.2 Temperature Transducer- tape transport main plate temperature indication fed to Data Encoder Subsystem for telemetry purposes.

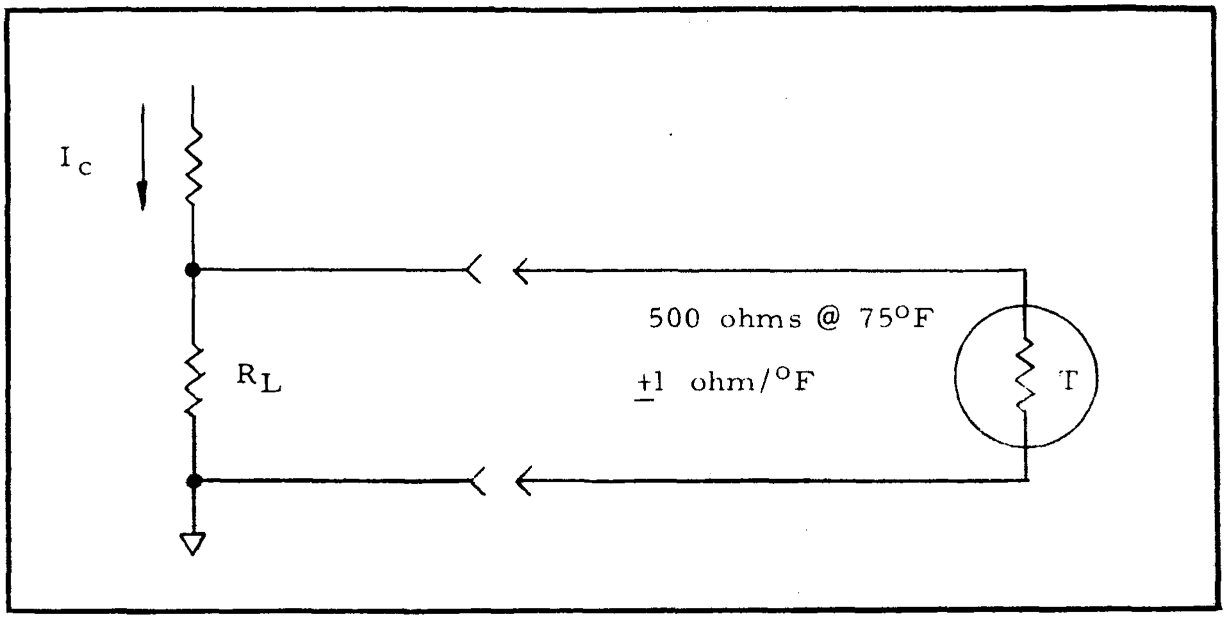

Figure 37, Temperature Transducer

9.3 Pressure Transducer- tape transport case pressure indication telemetered by the Data Encoder Subsystem.

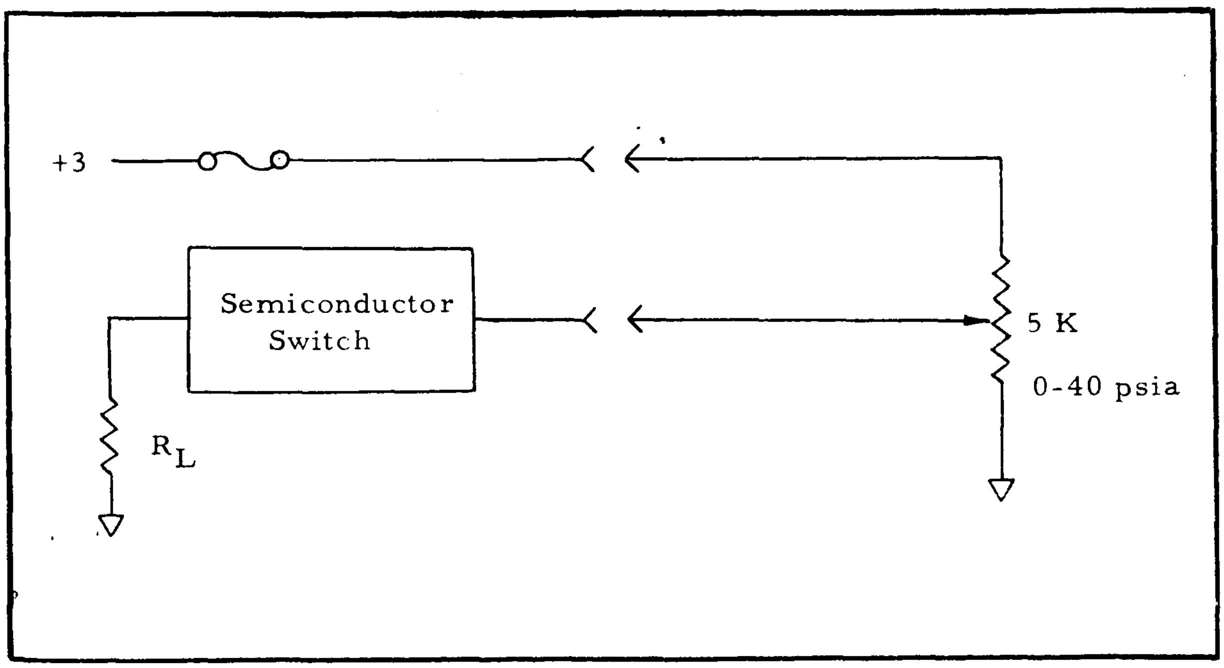

Figure 38, Pressure Transducer

10.0 TEST POINTS

10.1 In order to determine the location of a malfunction or operating anomaly a number of critical test points have been made available on the various subchassis. These test points should be connected to only with a low capacitance, high impedance, differential 'scope.

10.2 Subchassis 16A2 Test Points

10.2.1 Frequency Doubled Code Waveform TP-1/16A2 - output of peak detector section of recorder system. Reproduces recorded frequency doubled code waveform.

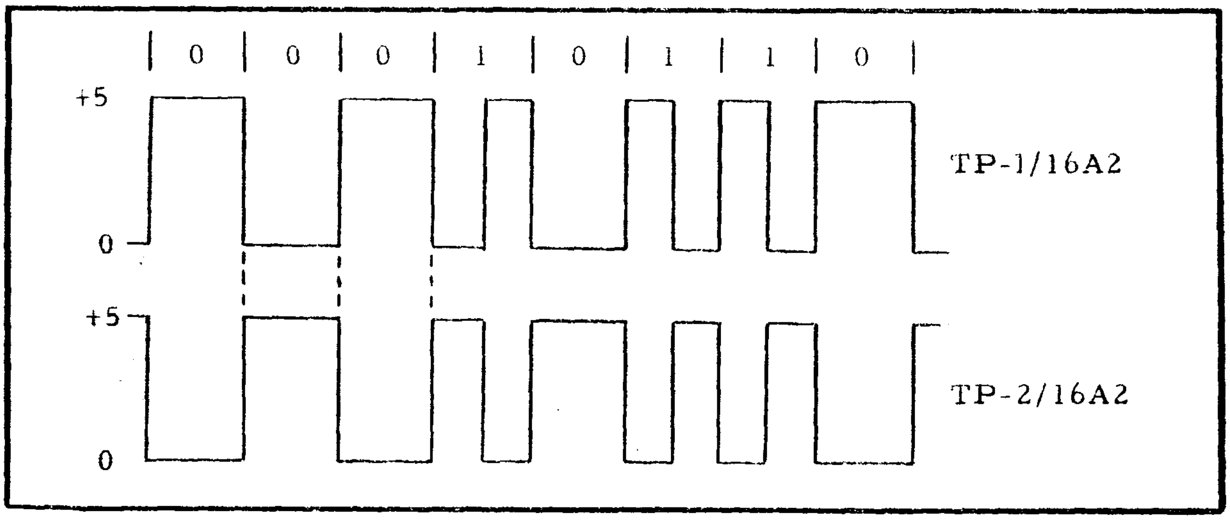

Figure 39, TP-1/TP-2/16A2

10.2.2 Frequency Doubled Code Waveform TP-2/16A2 - same as TP-1/16A2 except 180° out of phase.

10.2.3 Differentiator Waveform TP-3/16A2 - part of the peak detection section of the recorder. Signal observed is the derivative of the main playback amplifier output waveform.

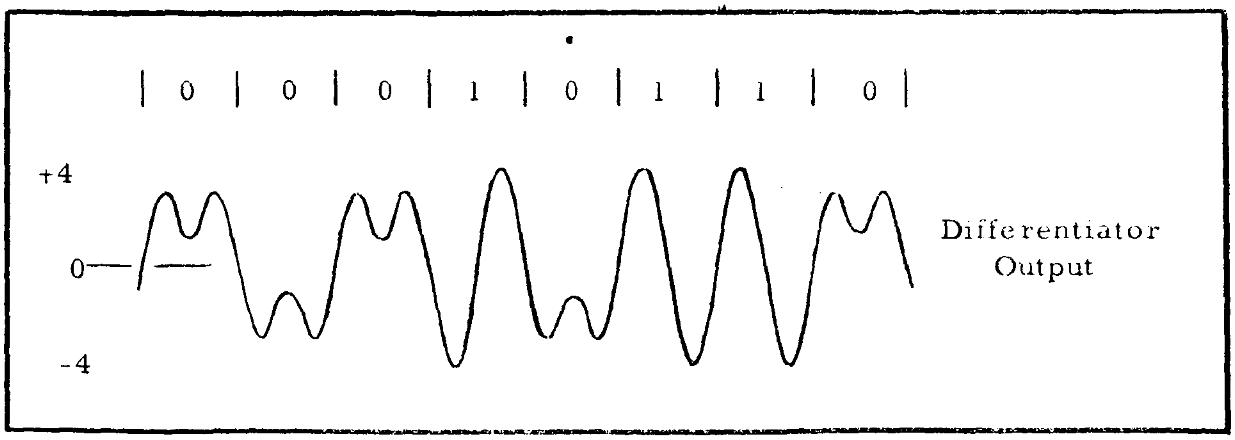

Figure 40, TP-3/16A2

10.2.4 One's Gate Waveform TP-4/16A2- a one-shot pulse generated whenever a logic "one" occurs while reproducing data. Triggering takes place on the center transition of a bit cell.

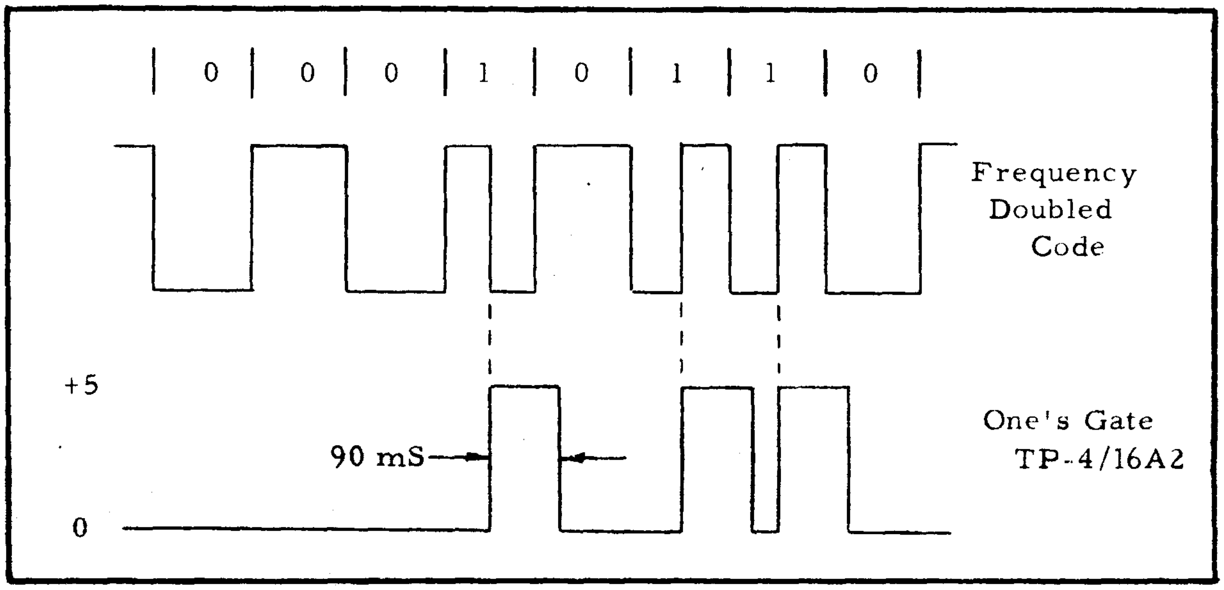

Figure 41, TP-4/16A2

10.2.5 Mode 4-1 Logic Signal TP-5/16A2- point identical to D/E interface line. See paragraph 8.3.14 for details.

10.2.6 Slaved Input to Phase Comparator TP-6/16A2- divided slaved bit sync from sync separator. Note phase relationship to integrator waveform.

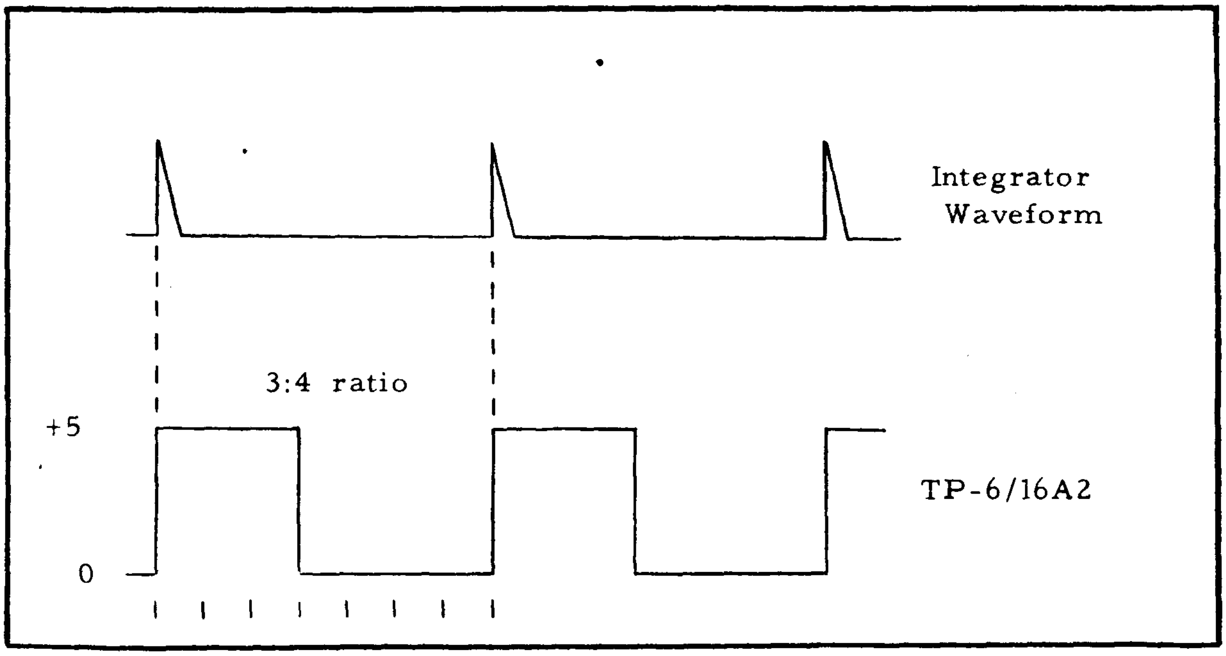

Figure 42, TP-6/16A2

10.2.7 Slaved Bit Sync Signal TP-7/16A2- bit sync separated from frequency doubled code. Triggering occurs on boundary transitions of a bit cell.

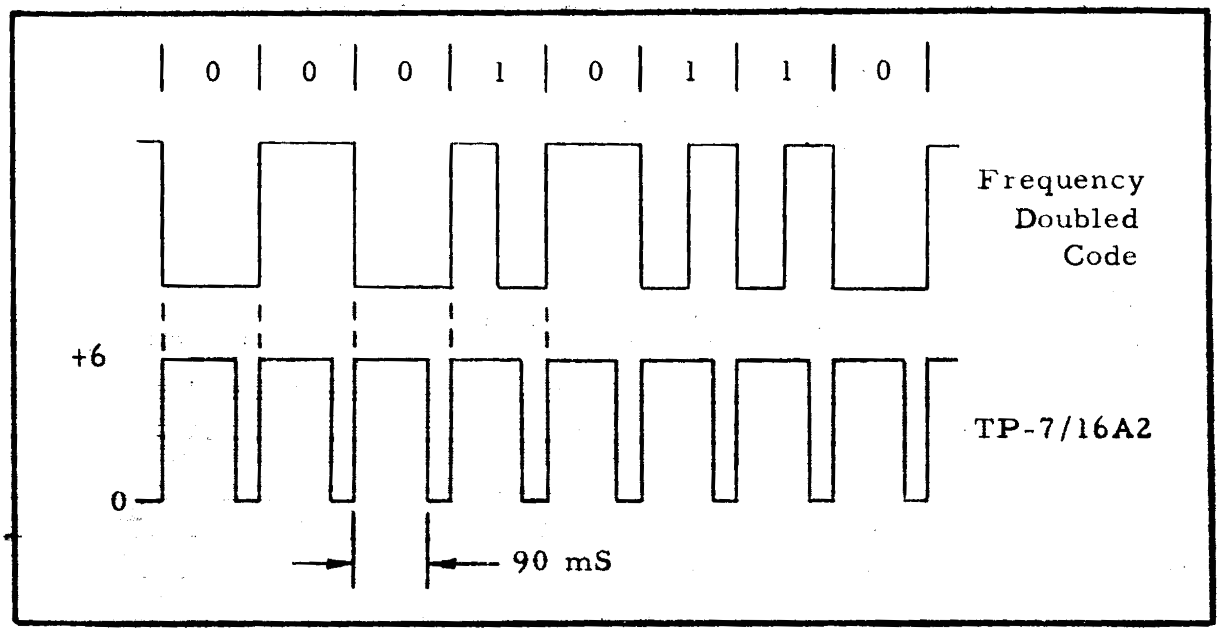

Figure 43, TP-7/16A2

10.2.8 Reference Input to Phase Comparator TP-8/16A2- divided master bit sync from Data Encoder. Note phase relationship to integrator waveform.

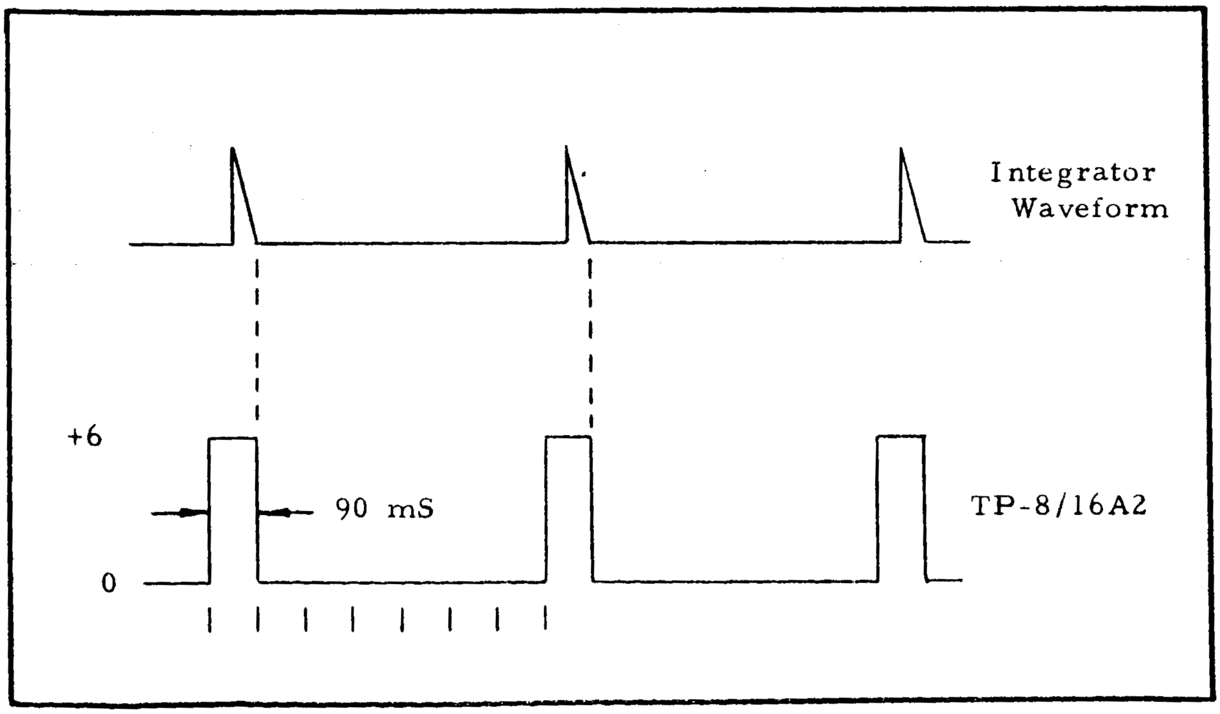

Figure 44, TP-8/16A2

10.2.9 Differentiator and Fullwave Rectifier Output TP-9/16A2- part of Frequency Doubled-to-NRZ Converter. Pulse occurs for every transition of the frequency doubled code.

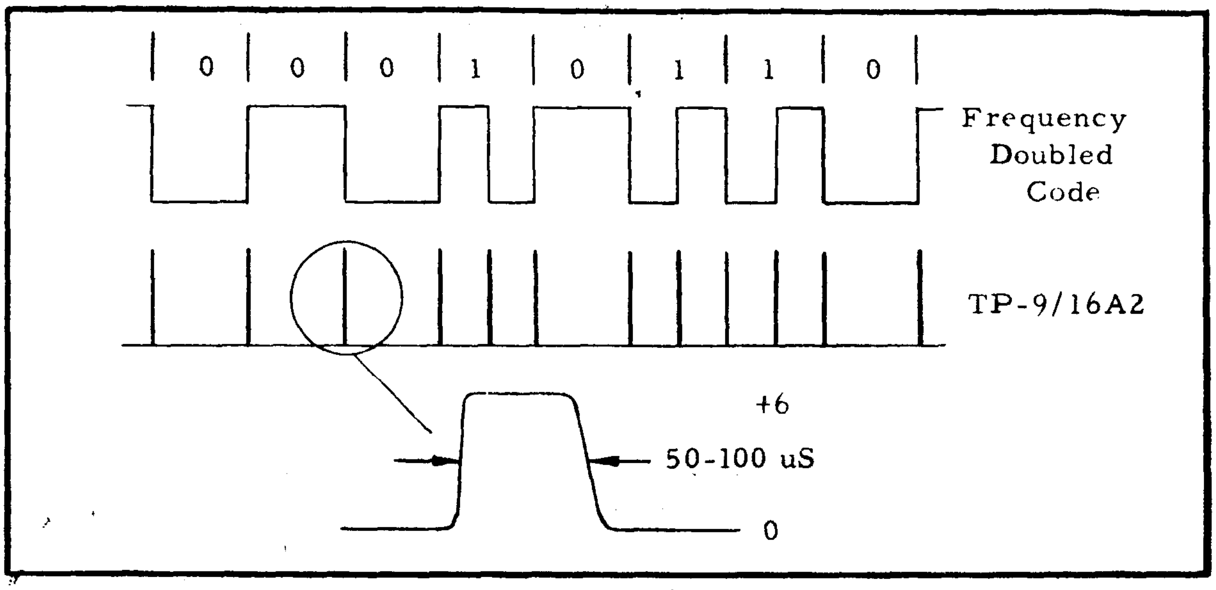

Figure 45, TP-9/16A2

10.3 Subchassis 16A3 Test Points

10.3.1 VCO Input Waveform TP-1/16A3- This point provides a means for externally varying the frequency of the VCO by applying an adjustable voltage source which overrides the integrator control signal. Open loop (asynchronous) operation of the recorder system is thus possible for test purposes. A VCO frequency between 1360 and 1660 cps can be achieved by applying a dc potential between 3.8 and 7.6 volts. During normal operation the signal appearing at this point is a reduced amplitude version of the integrator waveform.

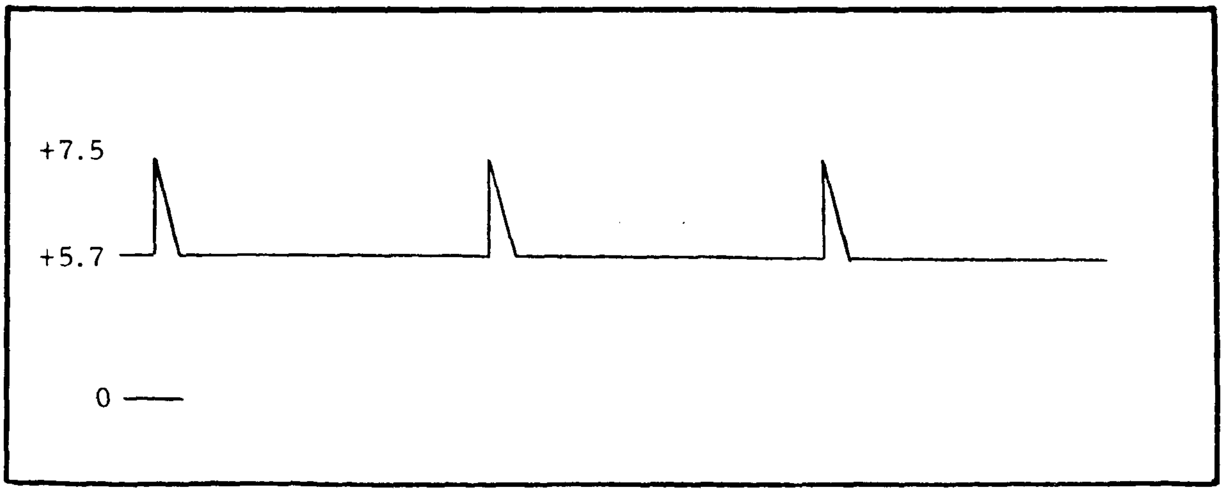

Figure 46, TP-1/16A3

RE-ORDER No.

10.3.2 <u>VCO Output Waveform TP-2/16A3-</u> output pulses from the voltage controlled oscillator. Frequency varies as integrator waveform varies.

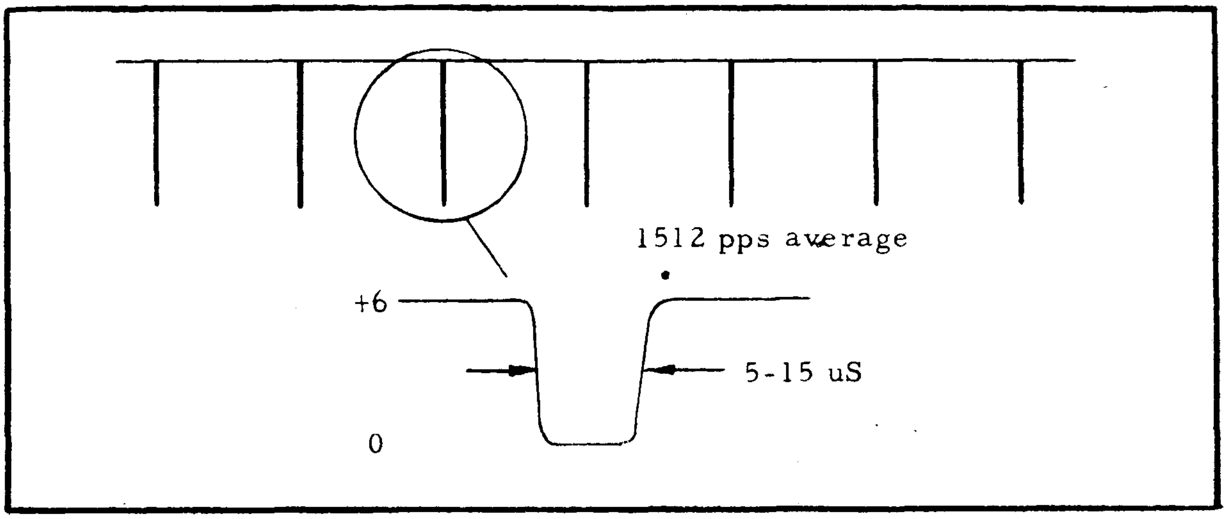

Figure 47, TP-2/16A3

10.3.3 <u>Track 2 Record Head Return TP-3/16A3-</u> indicates when power is applied to record head and allows rough approximation of head current balance.

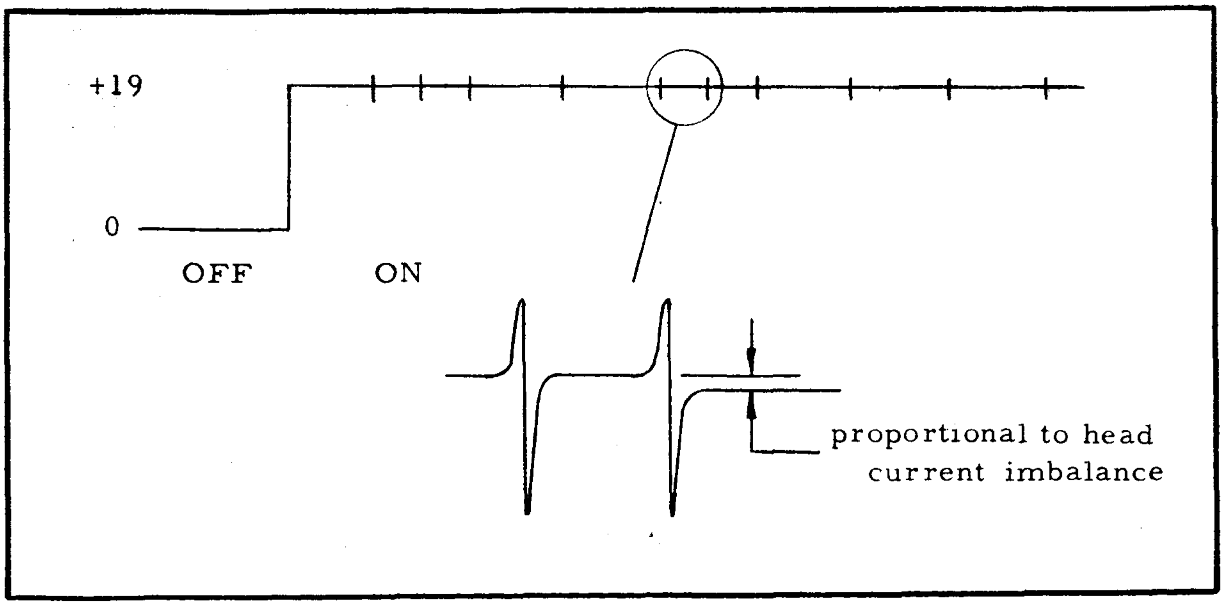

Figure 48, TP-3/16A3

10.3.4 <u>Track 1 Record Head Return TP- 4/16A3-</u> similar to Track 2 Record Head Return TP-3/16A3. See Figure 48 above.

10.3.5 <u>Playback Motor Drive Signal TP-5/16A3-</u> phase 1 logic signal to motor drive amplifier.

10.3.6 Playback Motor Drive Signal TP-6/16A3- phase 2 logic signal to motor drive amplifier.

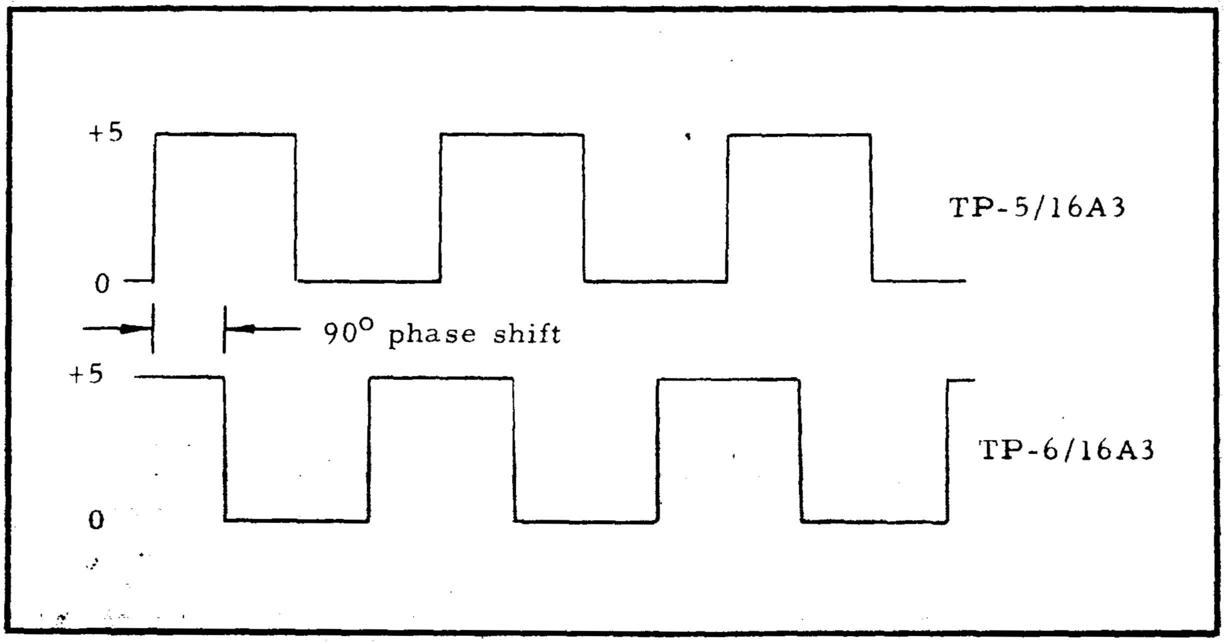

Figure 49, TP-5/TP-6/16A3

10.4 Subchassis 16A4 Test Points

10.4.1 +20 Volt Monitor TP-1/16A4- identical point to OSE interface. See Figure 36.

10.4.2 -20 Volt Monitor TP-2/16A4- identical point to OSE interface. See Figure 36.

10.4.3 +6 Volt Monitor TP-3/16A4- identical point to OSE interface. See Figure 36.

10.4.4 -6 Volt Monitor TP-4/16A4- identical point to OSE interface. See Figure 36.

10.4.5 Recorder System Common TP-5/16A4- electrical common of system. This point may be used as a reference for observing all other test point waveforms.

10.5 Subchassis 16A5 Test Points

10.5.1 RZ to Frequency Doubled Code Waveform TP-1/16A5- OR gate output pulse applied to flip-flop for code conversion.

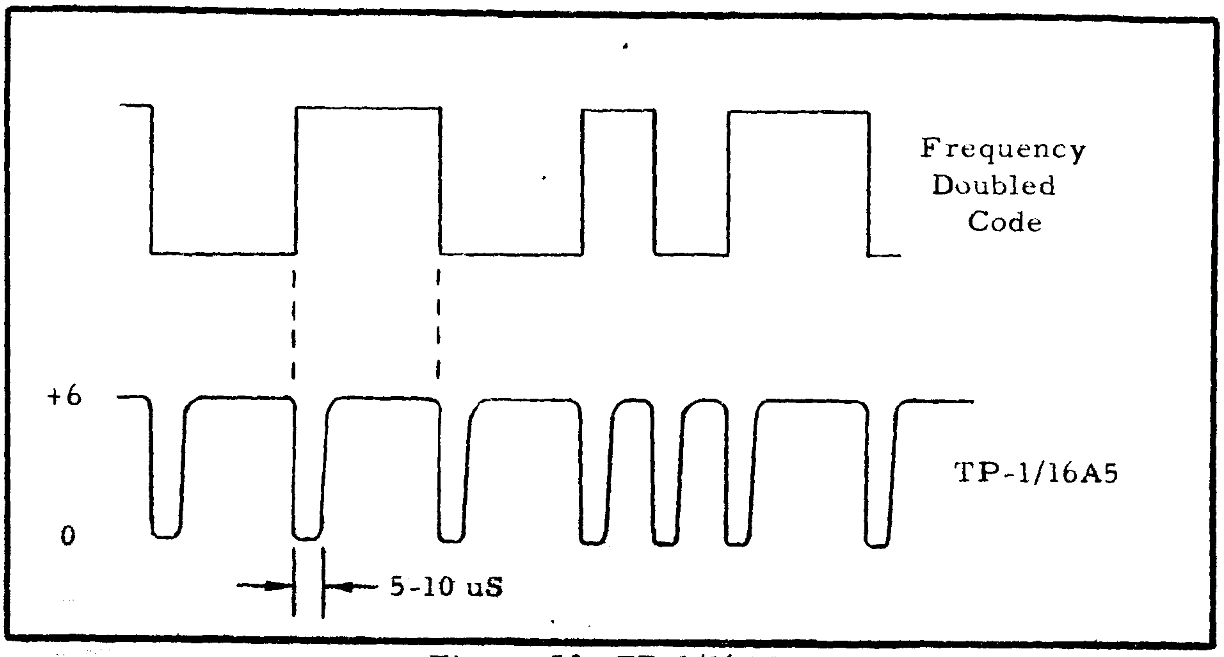

Figure 50, TP-1/16A5

10.5.2 Launch Mode Auxiliary Supply +6 TP-2/16A5- auxiliary supply output monitoring point. Because of its limited functional requirements, this supply is not well regulated. Level should fall between 5.5 and 6.5 volts when in a Launch Mode SET condition. During standby or RESET, voltage will rise to between 6.7 and 7.5 volts.

10.5.3 Launch Mode Auxiliary Supply -6 TP-3/16A5- not well regulated but is mainly subject to line rather than load variations. Level should remain between 6.0 and 7.0 volts.